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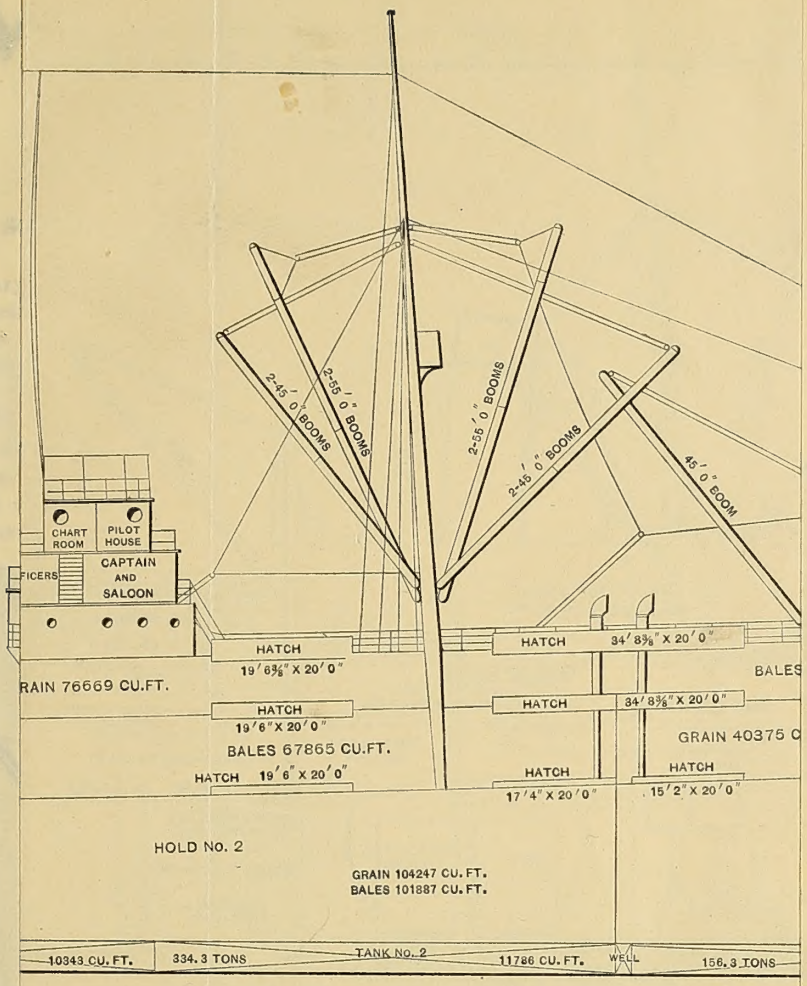
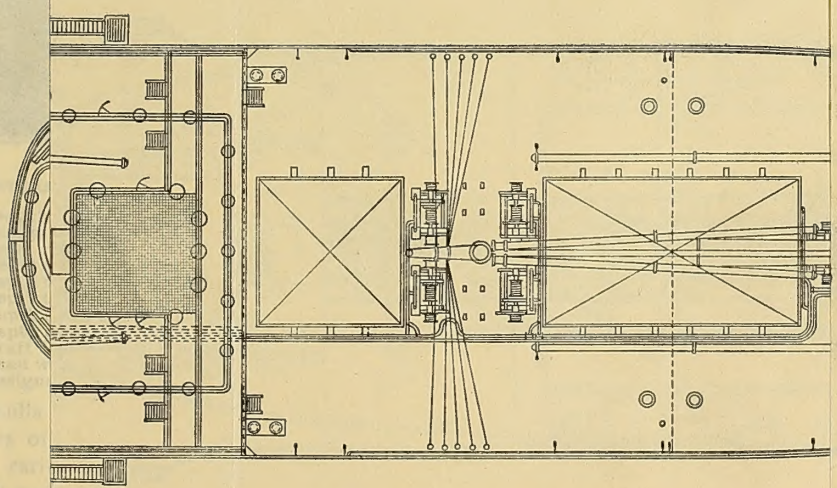
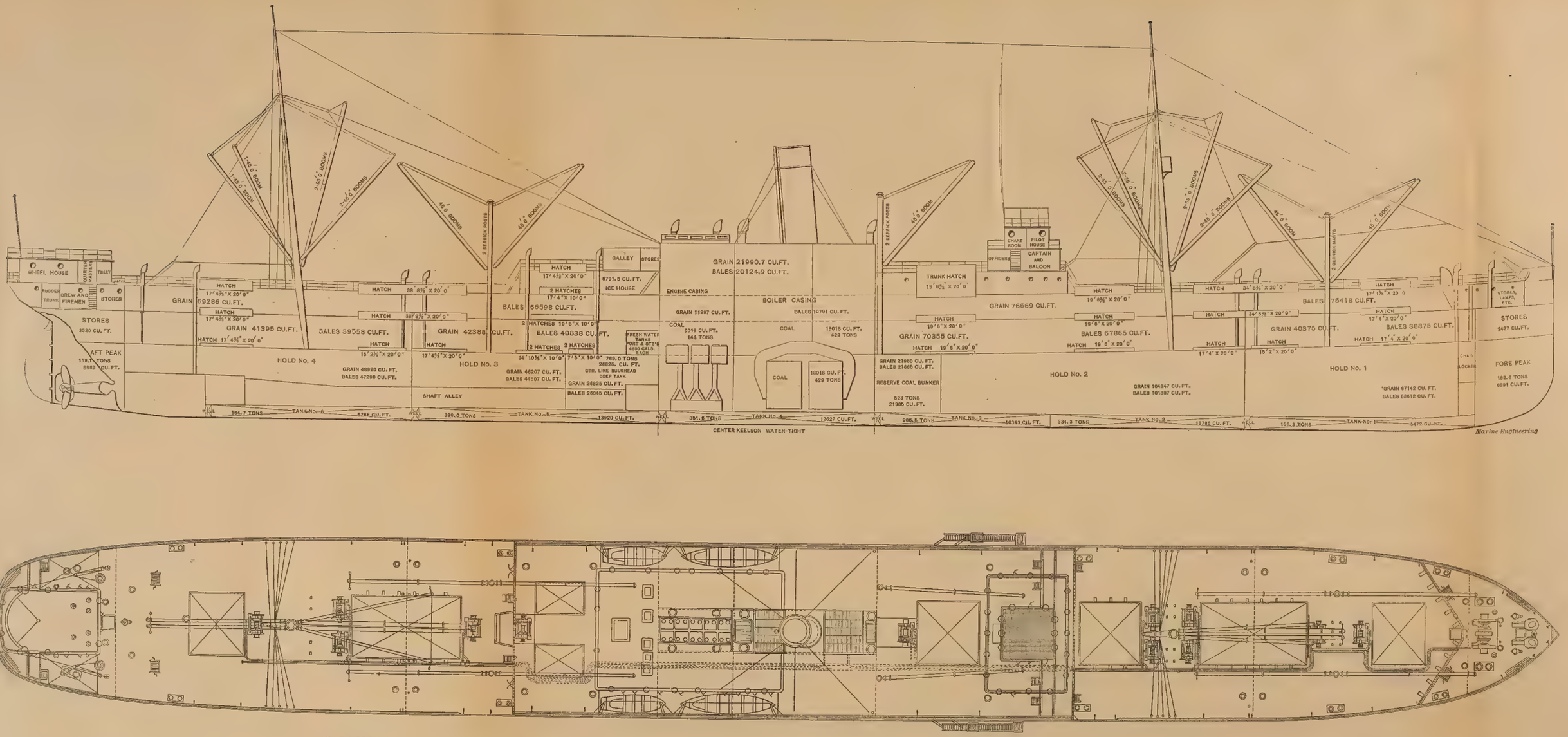




OR THE BOSTON STEAMSHIP COMPANY.

SUPPL



CAPACITY AND DECK PLANS OF THE TWO 11,000 TON FREIGHT STEAMSHIPS BUILT BY THE MARYLAND STEEL CO. FOR THE BOSTON STEAMSHIP COMPANY.

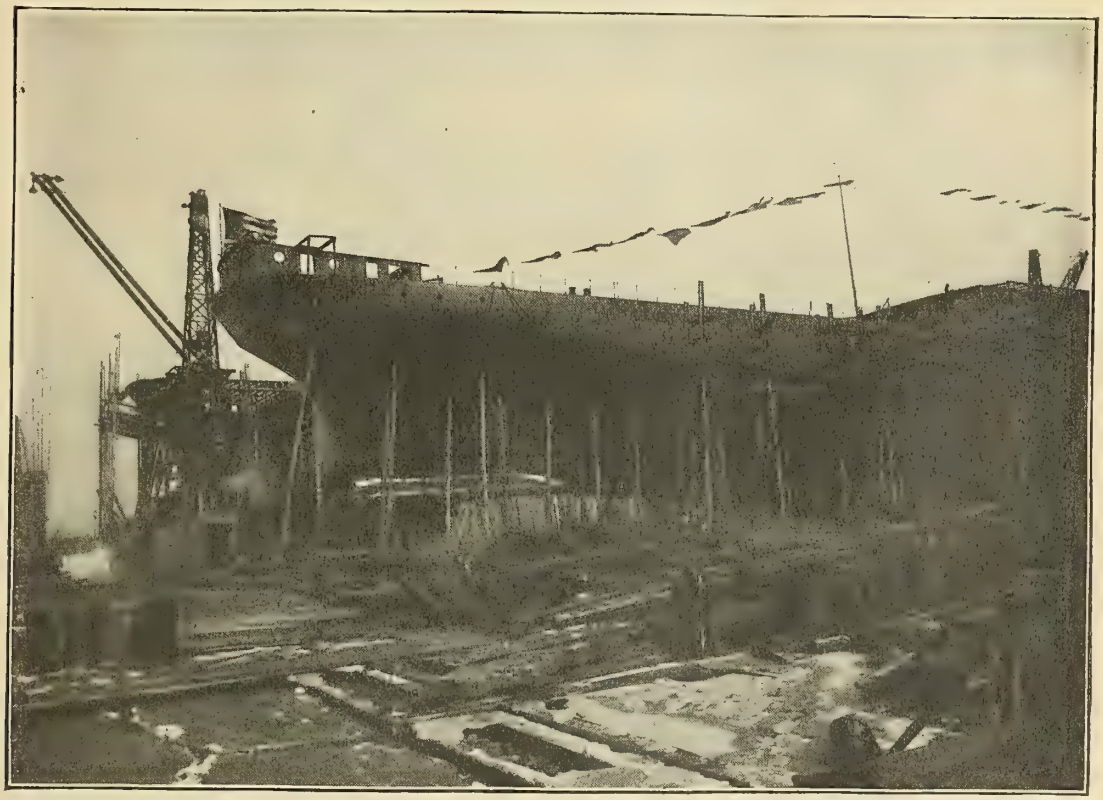
Marine Engineering

Vol. 7. NEW YORK, JANUARY, 1902. No. 1

NEW SHIPS OF THE BOSTON STEAMSHIP COMPANY.

The Maryland Steel Company have under construction at their yard at Sparrow's Point, Md., two of the first cargo steamers of a large size ever constructed in this country. The contract for these steamers was placed by the Boston Steamship Company, of which Mr. Alfred Winsor is President, in the fall of 1900, and the ships are now ready for launching. They have a very easy model and will no doubt exceed expectations when on trial.

The general dimensions are as follows:—



STEAMSHIP SHAWMUT LAUNCHED ON DECEMBER 23RD FROM THE YARD OF THE MARYLAND STEEL COMPANY.

Length between perpendiculars	488 ft. 0 in.
Length over all	505 " 0 "
Beam molded	58 " 0 "
Depth to Main Deck	22 " 1 "
Depth to Upper Deck	32 " 1 "
Depth to Shelter Deck	40 " 0 "
Depth to Bridge Deck	47 " 6 "
Depth of Water Bottom	4 " 2 "
Draft Loaded	27 " 3⅛ "
Dead weight capacity	11 000 tons.
Designed speed loaded	12 knots.

The hulls are of mild steel throughout, built under the rules of the British Corporation Society for the highest rating. Special attention has been given to strength and precautions taken to avoid the weakness which has developed on previous ships of this size.

There are three complete steel decks extending all fore and aft, and a steel bridge deck for 178 feet amidships.

Nine hatches extend through all decks, those in the deep tanks being divided into two smaller hatches.

Four water-tight bulkheads extend to the upper deck and one to the main deck, forming a deep tank.

The fore and after peak bulkheads extend to the shelter deck. Two non-water-tight bulkheads extend to the main deck, one forward of boiler-room bulkhead, forming reserve bunker, and one between engines and boilers.

The double bottom is built on the cellular system and extends from the forward collision bulkhead to just forward of the after peak bulkhead. The capacity of water bottom tanks is 2,100 tons, and the deep tank has a capacity of 770 tons.

The framing is of the "deep frame" type, but a considerable saving in material and labor has been accomplished by using an 11-inch channel split at the bilge. There are three hold stringers on each side, consisting of two heavy angles with intercostal plate to the skin. In addition to these a stringer of the same construction has been worked between the main

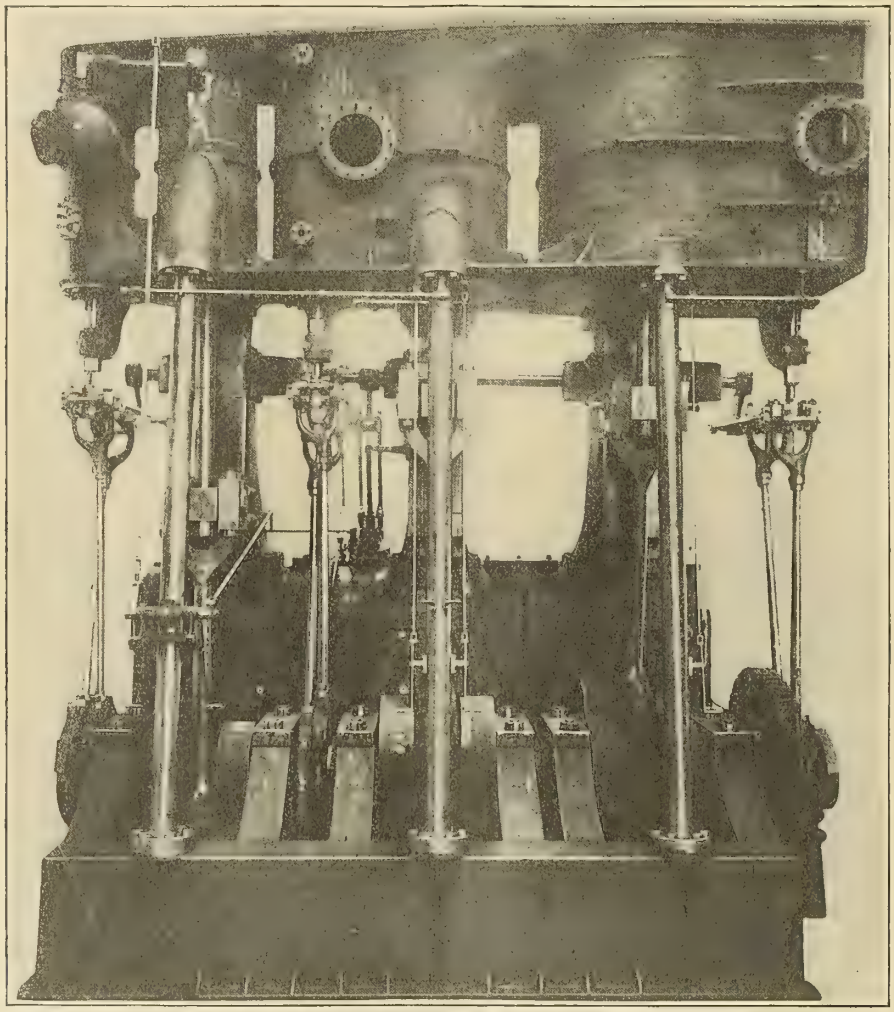
(Copyright, 1901, by Marine Engineering, Inc., New York).

and upper decks, forming a very rigid structure. The deck beams are on alternate frames on the main and upper decks and on every frame on the shelter and bridge decks. The stem and stern post and hangers are of cast steel, and the rudder is forged and of the single plate type. The shell plating is arranged on the "clinker" system, doing away with the necessity of cement in the water bottom.

In stanchioning these ships the system of wide-spaced stanchions with girders under beams has been used, after the style adopted by Alfred Holt, and which

cers have quarters in the forward deckhouse, with large dining saloon, captain's toilet, pantry, two spare staterooms, linen lockers, etc.

A private stairway leads to the chart-room and pilot-house, which are situated directly over the dining saloon. The crew have large quarters under the shelter back aft, with stairway from the house above. This house also contains two rooms for quartermasters, and separate bathrooms and toilets for seamen and firemen. At the after end of the house is located the steering gear, which is of the Brown Brothers'



TRIPLE EXPANSION ENGINE OF THE STEAMSHIP SHAWMUT.

was extensively described in Marine Engineering for August, 1900. This greatly facilitates the rapid handling of cargo, and, taken in connection with the arrangement of booms and winches, should shorten the time of unloading considerably. The capacities of the different holds can be seen from the accompanying inset.

A complete system of ventilation is fitted to each hold and 'tween decks, intakes being fitted at forward end of holds and outlets at after ends.

The engineers have large quarters in the house on top of the bridge deck, which also contains the galley, pantry and toilets for officers and engineers. The offi-

type, with telemotor in pilot-house and on flying bridge above. There is also a docking bridge on top of the after house, with docking and steering telegraphs connected to the pilot-house and forecastle head.

There are two pole masts, each provided with two 55-foot and four 45-foot booms and six derrick masts, four of which have two booms each and two have one boom each. All derrick masts are provided with cowls for ventilating the holds. Twelve winches of Hyde make, 8 by 10 inches, are located on deck, arranged with a view to quick handling of cargo. The windlass and capstans are of the Hyde make, both being ar-

ranged with engines on the deck below. There are two capstans aft, one on each side of the deckhouse for warping purposes. There are three metallic lifeboats stowed on bridges alongside the engineer's house, two 30 feet long and one 20 feet long, also an 18-foot cedar dinghey. Anchors are of the Baldt stockless type stowed in hawse pipes. The anchor crane is of the type used on Government work, and will be kept in a stowed position.

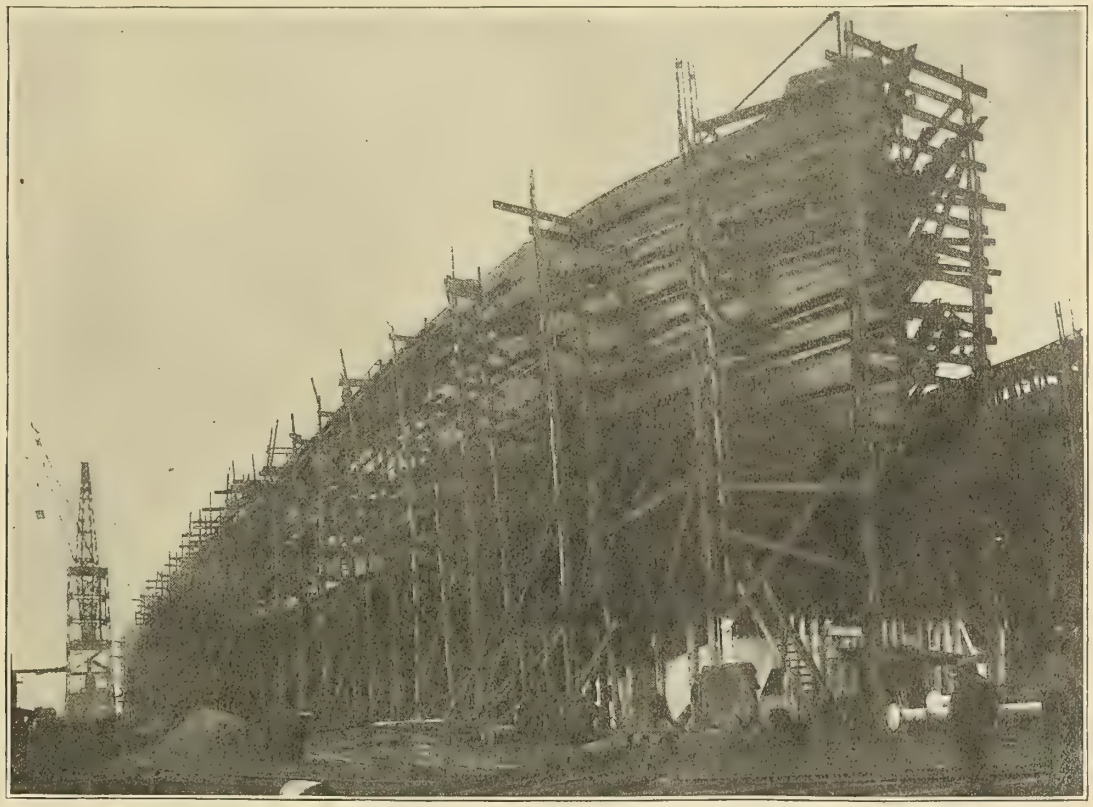
There is an Oregon pine deck on the bridge house and top of houses, and wooden ceiling over the bilges, no other wood being used for decking, and no spar ceiling being fitted.

forced in. The low pressure is fitted with double ported slide valves, with false face, secured with brass tap screws. A balance cylinder is fitted above the low pressure valve.

The valve gear is of the Stephenson link type, made of open hearth steel. The forks of eccentric rods and shaft arms are made of cast steel.

The reverse cylinder is a direct-acting steam ram, 12 inches diameter by 24-inch stroke, bolted to top and back of condenser, controlled by floating lever and with handle at working platform.

The crossheads are of open hearth steel, with cast steel shoe and composition gibs lined with white brass.



STEAMSHIP SHAWMUT ON THE WAYS, SHOWING TRAVELING CRANE TO LEFT.

The propelling machinery consists of two vertical, direct acting inverted cylinder, triple expansion engines, with cylinders 23 1-2, 39 1-4 and 63 inches in diameter, all having a stroke of 45 inches, and four single-end boilers 15 feet 6 inches in diameter by 10 feet 9 inches long, built for 200 pounds pressure. Each boiler has four 39-inch furnaces, giving a total grate surface of 276 square feet, and a heating surface of 10,752 square feet. The boilers are provided with Howden's forced draft, and are expected to provide steam for 4,000 I. H. P. under ordinary service conditions. The shafts are enclosed to the propeller in the well, known as the "Lundborg" style, and are in excess of the Registration Society's requirements.

The cylinders are of hard, close-grained cast iron, the high pressure having a liner forced in. High and medium pressure valves are of piston type with liners

The crank pin boxes are of cast iron, lined with white brass.

The back columns are box section of cast iron. Slides are of cast iron of slipper type, with cast iron keepers, and water circulation behind slide plate. Front columns are of forged steel. Eccentrics are of cast iron, with straps of cast iron, lined with white brass. Each condenser is in one piece, forming part of the engine frame, and is strongly ribbed. There are 1,196 tubes of 3-4 inch outside diameter, No. 18 B. W. G., tinned inside and out. These give a total cooling surface of 3,387 square feet to each engine.

The air pump is worked from the low-pressure crosshead and is of the usual vertical bucket type.

The thrust bearing is of the horseshoe type, with cast iron rings faced with white brass. Complete piping for water circulation is fitted.

The main steam pipe is of iron, lap welded, with semi-steel fittings and riveted flanges, all auxiliary steam piping being of copper.

Steam fire pipes are fitted to each hold, as required by law. The steam piping for winches and windlass is carried alongside the hatches on the shelter and bridge decks, and the piping for steering engine is carried through the shaft alleys.

There is a full equipment of auxiliary machinery. All pumps are of the Blake pattern. The other principal items are as follows:—

One Reilly evaporator of 35 tons capacity.

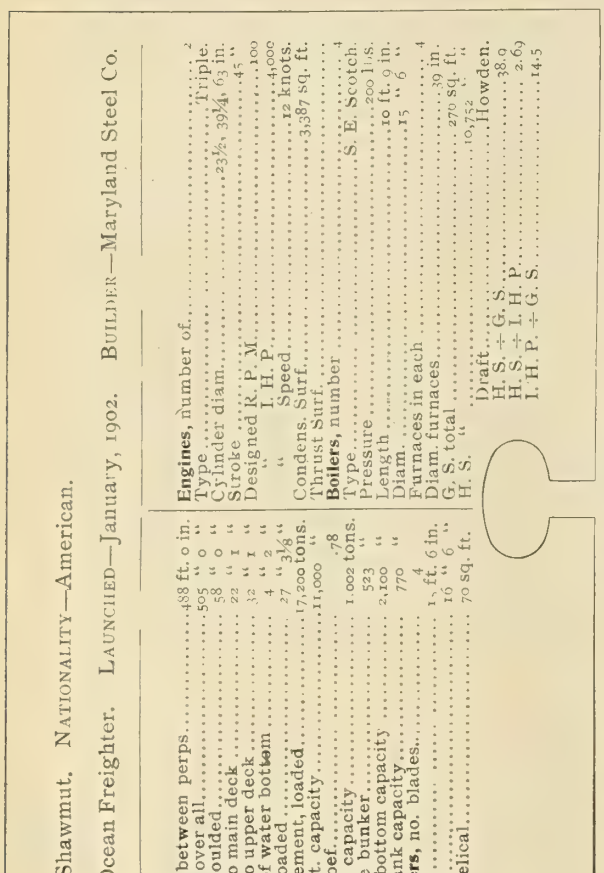
One Worthington feed heater.

Two 12-inch centrifugal pumps with 8 by 8-inch engines.

The electric plant is of the Sturtevant make for 300 16 c. p. lights, and is located in the thrust recess.

The propellers are of the built-up type, 15 feet 6 inches diameter, by 16 feet 6 inches pitch. The hub is of semi-steel and the blades of manganese bronze.

The second vessel is now completely framed, while the shell and deck plating are well advanced, and from present indications will be launched shortly.


NAME—Shawmut. NATIONALITY—American.
TYPE—Ocean Freighter. LAUNCHED—January, 1902. BUILDER—Maryland Steel Co.
Length between perps.....488 ft. 0 in.
Length over all.....505 " 0 "
Beam moulded.....58 " 0 "
Depth to main deck.....22 " 1 "
Depth to upper deck.....32 " 1 "
Depth of water bottom.....4 " 2 "
Draft, loaded.....27 " 3⅛ "
Displacement, loaded.....17,200 tons.
Dead wt. capacity.....11,000 "
Block coef.....78
Bunker capacity.....1,002 tons.
Reserve bunker.....523 "
Water bottom capacity.....2,100 "
Deep tank capacity.....770 "
Propellers, no. blades.....4
Diam.....15 ft. 6 in.
Pitch.....16 " 6 "
Area, helical.....70 sq. ft.
Engines, number of.....Triple.
Type.....Triple.
Cylinder diam.....23½, 39¾, 63 in.
Stroke.....45 "
Designed R. P. M.....100
" I. H. P.....4,000
" Speed.....12 knots.
Condens. Surf.....3,387 sq. ft.
Thrust Surf.....
Boilers, number.....4
Type.....S. E. Scotch.
Pressure.....200 l.s.
Length.....10 ft. 9 in.
Diam.....15 " 6 "
Furnaces in each.....4
Diam. furnaces.....50 in.
G. S. total.....270 sq. ft.
H. S. " 10,752
Draft.....Howden.
H. S. ÷ G. S.....38.9
H. S. ÷ I. H. P.....2.63
I. H. P. ÷ G. S.....14.5

Passenger Steamer for Lake Michigan.—The Graham and Morton Company announces that they will build a large passenger steamer for service between Chicago and St. Joseph.

Explosion on Board the Royal Sovereign.—During firing exercises on board the British battleship *Royal Sovereign*, of the Mediterranean squadron, a 6-inch gun exploded, causing the death of one officer and five men, while three other officers and sixteen seamen and marines were more or less seriously injured. The court of inquiry formed to investigate the cause of the explosion ascertained that the breech screw of the gun was by some means immaturely swung to before the operation was concluded of inserting the safe arrangement, which should prevent such an explosion.

Submarine Boat Fulton.—The test of the submarine boat *Fulton* was recently made in the waters of Peconic Bay, when the little vessel with her crew on board was submerged and remained under water for fifteen consecutive hours and then came to the surface. The men reported that they were able to sleep and eat, had plenty of fresh air, and suffered no discomfort whatever. The boat, however, was at rest, her machinery not running, so that there were no internal conditions to produce discomfort, such as might be the case in active service.

Shipping of Hong-Kong.—The importance of Hong Kong as a commercial center can best be understood when it is stated that seventeen million tons of merchandise enter and leave the port annually, a greater foreign tonnage than that of New York. Over three million passengers are landed at Hong-Kong during the year. Since our fleet has become a fixture in far eastern waters a constant activity has been evinced by each of the commercial nations, realizing, as they do, that we have entered the far eastern situation to take from them, in open competition if we can, the trade advantages they have won.—*Iron Age.*

New Shipyard on the Lakes.—The Columbia Iron Works, at Port Huron, Mich., has acquired land on the St. Clair River, with about 1,400 feet frontage, preparatory to installing a modern ship-building plant. Good progress has been made in the grading, and pile driving will be carried on as the weather will permit. The buildings will be proceeded with as soon and as rapidly as practicable, and early in the season the plant should be ready for work on the two ships for which plans are now in preparation. These are a new type of grain carrier, 405 feet in length, and a lumber boat 180 feet in length.

Liquid Fuel.—At a meeting of engineers in Odessa, Russia, the engineer for the Russian Steam Navigation Company read an interesting paper on the subject of Oil Fuel for Steamers. He stated that Russia was the pioneer for the use of oil for propulsion at sea, as the vessels plying along the river Volga have for many years used *ostaki* or oil residue, for fuel in the boilers. Other vessels built in England for this company, equipped in burning coal, have had their furnaces changed for oil burners. He further states that after many experiments it was demonstrated that in the cost of the two fuels the cost of oil per mile amounted to only one-third that of the coal. Among the other advantages are, cleanliness, ease in regulating the amount of steam generated, saving of labor and waste. Similar experiments are to be carried out by the Russian Government.

NOTES ON THE EQUIPMENT OF FOREIGN SHIPYARDS.

BY PROF. C. C. THOMAS.

The Clyde is properly referred to as "The cradle of shipbuilding," and one finds there frequent reminders that many of the most prominent men of the professions of engineering and naval architecture have spent their lives developing the marine arts on the shores of that famous river. It follows, therefore, that there is, for the engineer, much of historical interest in the vicinity of Glasgow, and perhaps the Clyde presents more object lessons in the history of engineering than can be found elsewhere in the world. All along both banks of the river, from Glasgow to the sea, are shipyards and engineering works, many of them bearing names which are as familiar to the engineering world as is the name of the river itself. Each of these works, however, belongs to one of two general classes, which are, those which have kept up with the advancements in equipment and organization, and those which have not. The concerns are, as a rule, all of many years' standing, and one is surprised to learn that some of the largest and best equipped vessels have been built at yards, which at first sight at least, appear to be too poorly fitted out and too old fashioned in methods to attempt such work. Some yards do merchant work entirely, not attempting Government or large passenger contracts, and, of course, there are many concerns fitted up for building only the smaller classes of vessels.

It is not too much to say, and it is to be expected where there are so many competitors in a small section, that the greater number of the Scotch yards give the impression that the hand of prosperity has not opened bountifully over them, at least of late, and no doubt this impression becomes more real on account of a few among the number of shipyards and engineering establishments which do show such marked signs of resource and efficient and wide awake management. Among the latter class stand out pre-eminently the Clydebank Shipbuilding and Engineering Works, the Fairfield Ship and Engine Building Co., and the Engineering Works of David Rowan and Company. The latter company confines its attention to the building of engines and boilers for merchant service, while the two shipyards mentioned carry on the building of vessels of all kinds, from yachts and torpedo boats to ocean liners and battleships. These yards also build a great deal of the auxiliary machinery required in their contracts instead of purchasing it from outside concerns.

In these works, which are mentioned because they show what we may take to be the result of the most advanced opinions in Scotland of desirable engineering methods, while there are certain details of construction in the shops which are at variance with American methods, the improvements in the engine and boiler departments are mostly just such as our own large establishments are using. In fact, one finds many of our own improved tools in use on the Clyde, notably wood working tools, turret lathes, screw cutting machines, key seaters, and, in some cases, pneumatic chipping and caulking tools and pneumatic drills. Not many yards in Scotland, however, are equipped with compressed air plants, and those that are do little pneumatic riveting, the latter being a method of the utility of which the Scotch engineers are not yet convinced. In July last an exhibition of pneumatic riveting was given in the exhibition grounds at Glasgow, and was witnessed by various engineers and ship builders. The result was not favorable in the eyes of those present, as one at least of the rivets was found, upon cooling, to be loose, so that it could be twirled about in the hole. This called forth considerable criticism upon pneumatic riveting; much of the criticism being, no doubt, well founded, but in general based upon a quite limited knowledge of what had been done in that line in America. The writer failed to find many ship builders in England and Scotland who were favorably disposed towards riveting any portion of the ship with air tools, the chief objections being that the work could not be so well done, and that the economy claimed for the system was very doubtful, considering the compressors and small tools involved, which required frequent repairs. The same attitude exists among the builders in Germany, some of whom said they used the pneumatic tools only to frighten the men into not striking, but that, as a matter of fact, even for chipping and caulking they could do the work more cheaply by hand than with air tools, and that while it took a somewhat greater length of time, a better job could in most cases be done by hand. At the Vulcan Works, Stettin, however, the management is more favorable towards pneumatic tools, and contemplates the installation of whatever has been found successful in that line. In England, Scotland and Germany much of the heavier riveting on hulls is done by portable hydraulic tools, and for boiler work, of course, the hydraulic system is in use at all the large shops.

Returning to the Scotch yards, the principal difference between their best yards and ours, is in the methods of handling material from the shops to its destination on the ships. In the smaller yards the material is hauled, as of old, upon hand trucks over the ground from the plate and angle shops to the building ways, where it is hoisted into place by the help of tackle; the hoisting being done usually by a small steam winch. In the larger yards, narrow gauge tracks are laid from the shops to the ways, and hydraulic lifts are placed at various points along the sides of the ships. The material is transported from the shops to these lifts by means of small trucks running on the tracks, the trucks being moved by men or horses. An arrangement has been laid out in these yards so that cars from various railway lines may deliver material at the plate and shape stacks. From these stacks tracks run to the various shops, and locomotive cranes are used for handling material to and from the cars.

Exception should be made in the case of some of the yards on the Tyne, notably Messrs. Swan and Hunter, of Walsend, where one finds more labor saving appliances of modern type than are in use upon the Clyde. They are equipped with electric, hydraulic and pneumatic plants, and have experimented considerably with pneumatic riveting, but like many others, are disposed to confine the work of the pneumatic tools to drilling, chipping and caulking, as the

riveting seems to require an amount of collateral work which overruns in cost the economy due to the more rapid work of the hammers themselves.

Messrs. Swan and Hunter's yard is equipped also with sheds over the building ways, which carry overhead traveling cranes by which material is lowered into place upon the ships. These, with the large cantilever crane recently installed there, place this firm decidedly in the front rank among British ship builders; in fact, so far as the writer has seen, according to American ideas, the Walsend Works have a more modern equipment for handling material than any other yard in Scotland or England.

While in the less progressive and perhaps older yards the tools and arrangements are in many instances very much out of date, still in the works which are in Scotland and England considered up to date, the tools in the various shops are of the very best, and the relics have been set aside where they can be looked upon with reverence by the visitor, but they are retired from active service and their places are taken by modern appliances. In the older yards, however, patriarchs of fifty years are still at work in many cases.

In several of the engine works which have been, at least in part, equipped with new tools and improved overhead traveling cranes, the old buildings remain, and the head room is cramped. In many instances, in new as well as old shops, the vertical engines are erected in pits, so that they can be served by the cranes more conveniently and the engines are rendered more easily accessible for the workmen.

Germany has entered the field of shipbuilding upon a large scale in comparatively recent years, and the large yards are laid out according to modern ideas; the machine tools throughout are the best obtainable, and about the works is an air of system and organization that is perhaps the first thing that impresses the visitor. Prosperity in shipbuilding is more apparent in Germany than in Britain, though the equipments of the best yards of the latter compare favorably with those in the former country. There are, however, three yards in Germany of such magnitude, such excellence of equipment, and controlled by such progressive management, that they call forth the greatest admiration even from an American visitor. These yards are the Vulcan Works at Stettin, the Germanic Works at Kiel, and the Works of Messrs. Blohm and Voss at Hamburg.

There have been some very expensive works recently established at Vegesack and at Wilhelmshaven, which are fitted out with the most modern tools and handling devices, but of these works the writer knows only by hearsay. Mention should also be made of the Schichau Works at Danzig, where many of the smaller vessels of the German Navy have been built.

Messrs. Blohm and Voss occupy a most excellent position on a peninsula jutting out into the Elbe River, at Hamburg, and in one of the busiest parts of that crowded harbor. On account of this favorable location, repair work in great quantity comes to this yard, and the equipment of floating docks, graving docks, cranes and marine railways is capable of handling a great deal of this line of work. Their dry docks are among the largest in Europe. Messrs. Blohm and Voss employ in the neighborhood of five thousand men, and have in hand a large quantity of new work, among the vessels being the battleship *Prinz Karl*, and two large twin screw passenger and freight steamers for the Hamburg-American line. At these works pneumatic tools are not looked upon with favor, for reasons already given as coming from German builders, hence the air plant is little used, and not at all for riveting.

The great number of shipyard plate and shape working machines are operated by small steam engines directly connected to the individual machines, there being almost no belting employed in the shipyard sheds. The material for the hulls is handled in the usual way in the shops by overhead tracks and small cranes serving each machine.

The transportation of plates and shapes to the ships, however, is still done by the old fashioned means of small trucks, and it is hoisted into place by stationary pole derricks alongside the building ways.

Everything about the various departments of this establishment is of the best class and embodying the most modern improvements, with the exception of the devices for handling material from the shops to the ships. Messrs. Blohm and Voss have the third largest works in Germany and it is certainly one of the most efficiently organized and managed.

The largest works in Germany and that which has turned out the finest passenger steamers in the world, is the Vulcan Works at Stettin. Next comes the Germania Works at Kiel. At each of these works one sees material carried to its place upon the ships by overhead traveling cranes, which run on tracks carried in the tops of steel sheds build over the building ways. The sheds at Kiel are decked with glass, while at Stettin there is no covering over the ships, excepting the steel shapes of the building.

Of the works at Stettin, too much cannot be said in praise of the enterprise with which improved methods are being employed, and the general air of business and forehandedness speaks well for the utility of those methods.

At the time of the writer's visit at Stettin the *Kron Prinz Wilhelm* was about to leave for her trial trip to New York, the *Kaiser Wilhelm der Zweite* was partially in frame, and several battleships, cruisers and merchant ships were under way. At the Stettin Works are employed from six to seven thousand men, and at Kiel the number is from five to six thousand.

It is said that overhead cranes for shipbuilding ways were first built upon the Tyne, and that our American devices are developments due to the proverbial Yankee enterprise and ingenuity. Certain it is, however, that in many respects our American shipyards show far more machinery of modern type than do the British yards, and that the Germans are following in our footsteps in equipping their plants. In moving among industrial institutions in the older countries one soon finds that the name American is almost synonymous there with enterprise, economy and quickness of production. True, it is, that we find a ready market abroad for such articles as shoes, typewriters, electrical machinery of various kinds, and that we send large quantities of

steel billets, rails and various shapes—raw material, such as copper, tin and arsenic, and machinery in the form of locomotives and various machine tools. But let us remember that with all our labor saving devices, we have yet to show foreign vessel owners that we can build their merchant and passenger steamers for as low prices as they can get them in the British yards. Our prices are higher also than those quoted by German builders.

No doubt the facts that our labor saving appliances are quite new, and that the introduction of new methods takes time, that wages are higher with us, and that our yards are full of work for American owners, account largely for our higher quotations. Also just as the American workmen require higher wages than those in Britain and on the Continent, so the American proprietors probably figure on a higher percentage of profit in their contracts. American competition has become a very real thing to many industries across the Atlantic, but we must remember that while in the materials used in shipbuilding we have come to produce more cheaply, still in the finished product our costs are still too high to compete with foreign builders.

The above suggests that, before closing an article like the present, a few words should be said relating to the laborers, as well as the tools wherewith they work. The two principal factors determining the relative importance of countries in the commercial and industrial world are, the availability of supplies and the willingness of the people to work. Coupled with favorable natural conditions must be an energetic, enterprising people, or, in other words, industries demand industry. They are the products of the work of brains and hands, hence the personal peculiarities and habits of thought and action of the community determine what position it shall hold relatively to that of other communities equipped with natural resources commensurate with its own.

Skill in certain lines is the possession of the mechanics of certain countries, and those that have been engaged in particular industries for long periods have discovered and adopted methods of work which give them an advantage over later arrivals upon the field. In the manufacture of certain types of machinery and many articles of steady consumption we have come to produce so cheaply that other countries have not been able to meet our prices. This is attributed largely to the greater snap and energy of American workmen, and there is reason to suppose that by the adoption of methods for reducing cost of labor in shipbuilding and marine engineering we shall be able to turn out as large and fine ships as anybody, and at satisfactorily low costs. We are as yet far from having attained to this, however, which is no doubt largely due to the greater experience of the foreign engineers in the building of large work, their methods of standardization of machine parts, and the paying of workmen by the piece-work system.

Americans do not need to be told that in Great Britain one finds an energetic, ambitious working people, and that in any gathering of scientific men in England or Scotland, one has the honor of coming in contact with the sterling character and strength and culture of mind which make us proud to claim oneness of ancestry with them. Two elements, however, are militating against England's industrial progress, and nobody realizes better than the men in charge of institutions, that conservation on the one hand in adopting new methods, and trade-unionism on the other (preventing their profitable use when such methods are adopted) combine to prevent England from keeping pace with countries which have fewer traditions and less compunction about throwing away those which they find moss-grown. While the adoption or non-adoption of certain methods plays a most important part in determining what countries shall be the successful competitors, the question of first importance is the willingness and energy with which the workingmen further the interests of the concerns by which they are employed.

In some of the works which the writer visited, Friday was payday, and the men in the shops took certain liberties with their time on that day; Saturday was a half holiday, which seems to make more or less laxity necessary during the hour or so before quitting time, and on Monday there was less work going on than on either of the two days just mentioned. This left three days of the week in which full time was put in, and this state of affairs, which, happily has no parallel in America, seems to be due to the so-called independence which the men feel in relying upon their unions.

The questions which have been recently brought up in various publications concerning the reason that American competition is successful seem to be more nearly answered by the statement that we work harder, than by discussions of particular methods and systems, however important these may be. While we in America are confronted by serious problems, and can in no wise afford to rest upon our oars, our salvation lies in the fact that we do not ask for a chance to rest, but rather for opportunity to work harder and earn more money.

The unpleasantness of the past summer between labor and capital in this country, and many other instances, might be cited as challenging such a statement, but these volcanic eruptions have their origin in the ambitions in one class or the other. They bespeak a desire to get ahead rather than a tendency to do less work.

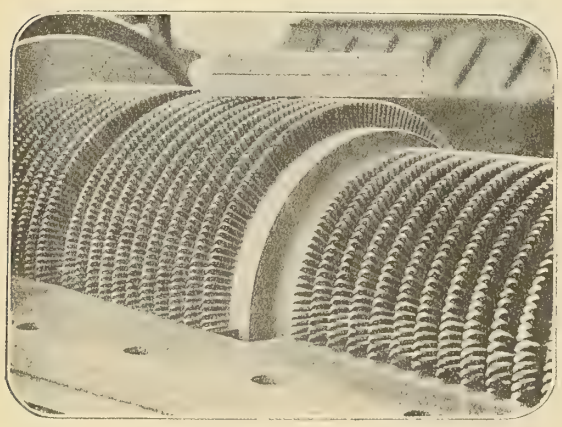
In general engineering production, England has long been a great factor; Germany has become a most active producer, and France is especially strong in certain lines. To the United States, however, the eyes of the industrial world are turned at present, as possessing the most promising combination of natural resources, brains and labor, together with a boldly progressive spirit in attacking and simplifying problems of engineering production. It is rather the combination of these desirable qualities that attract attention, than the possession of individual endowments of greater degree than other peoples. The last mentioned characteristic, however,—the boldly progressive spirit, or, in other words, lack of conservatism,—is generally believed to be more in evidence in the United States at the present time than in the other industrial nations.

TURBINE STEAMER KING EDWARD.

BY W. CARTILE WALLACE

Few if any innovations in marine engineering during the last quarter of a century have excited greater interest among engineers of every class than the application of the steam turbine to marine propulsion, more especially so since it was brought under the immediate notice of "the man in the street," so to speak, by the placing of the steamer *King Edward* on the Clyde during the early days of the Glasgow Exhibition.

While attending the Engineers' Congress, the writer, through the courtesy of the management, had an opportunity of spending a day on board this vessel and of becoming thoroughly conversant with her in every detail, and it has occurred to him that some information concerning this boat and the general impression her arrangements made on him might be of interest to the readers of MARINE ENGINEERING.



THE BLADES OF A PARSONS TURBINE.

It is hardly within the scope of this article to describe at full length the construction and working of the Parsons turbine, as its application to the driving of electrical generators dates back more than a decade, and its general principles are well known to engineers. But the improvements made since its first inception have been very great and the results correspondingly improved, so that from being considered one of the worst "steam eaters" it has come to be admittedly one of the most economical engines in existence.

The turbines fitted in the *King Edward* are those of the parallel flow type. This consists of a cylindrical case with rings of inwardly projecting blades, within which revolves a concentric shaft with rings of outwardly projecting blades. The rings of blades on the case nearly touch the shaft, and the rings of blades on the shaft lie between those on the case and nearly touch the case. Fig. 1 shows a section of the compound steam turbine as applied to the driving of dynamos. Fig. 2 shows one form of blades which is used. Steam entering at A (Fig. 1) passes first through a ring of fixed guide blades, and is projected in a rotational direction upon the succeeding ring of moving blades, imparting to them a rotational force. It is then thrown back upon the succeeding ring of guide blades, and the reaction increases the rotational force. The same process takes place at each of the successive rings of guide and moving blades. The energy to give the steam its velocity at each successive ring is supplied by the drop in pressure, and the steam expands gradually by small increments.

At the end of the spindle B are grooved pistons or dummies which fit into corresponding grooves in the cylinder. The object of these dummies is to prevent end thrust, and there is, therefore, a passage in the cylinder between each diameter of the spindle and the dummy of the same size. The dummies also act as a practically steam tight joint, since the clearance between the grooves can be adjusted longitudinally by a thrust block in the end oil keep. The bearings are of the tubular pattern, and, owing to the light weight of the revolving spindle, the wear is so small that the bearings often run for several years without being touched.

The turbine as applied to marine propulsion is so modified that the thrust of the propeller is entirely balanced by the internal action of the steam on the rings of blades. This reduces friction to a minimum, and only a comparatively light thrust block is required simply to steady the shaft and prevent the end play.

To return to the *King Edward*, her dimensions are: 250 feet length by 30 feet beam, by 10 feet 6 inches

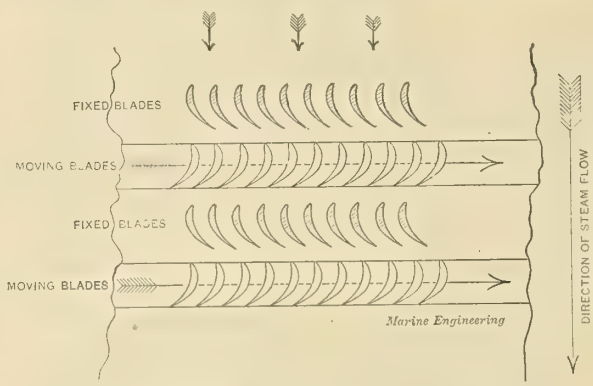


FIG. 1. SECTION OF STEAM TURBINE.

molded depth to main deck, and 17 feet 6 inches molded depth to promenade deck. Her general arrangements are somewhat similar to those of the usual type of modern river pleasure steamer as seen principally on the Clyde.

The machinery consists of three separate turbines driving three screw shafts. The high-pressure turbines are placed on the center line, the two low-pressure turbines each driving one of the outer shafts. Inside the exhaust ends of each of the latter are placed the two astern turbines, which are in one with the low-pressure motors, and operate by reversing the direction of the low-pressure turbines and outside shafts. Under ordinary running conditions these astern turbines work in the vacuum of the condenser and absorb no power whatever, this arrangement for reversing being by far the simplest and most effective of the many methods which have received the careful consideration of the patentee. When under way, the

steam from the boiler is admitted to the high pressure turbine, and after expanding about five fold it passes to the low pressure turbines, and is again expanded in them about another twenty-five fold, and then passes to the condensers, one of which is on each side of the vessel, the total rate of expansion being about 125 fold.

At twenty knots, the revolutions of the center shaft are about 700 and the two outer shafts 1,000 per minute.

There are five propellers in all, one on the center shaft, 4 feet in diameter, and two on each of the side shafts, 3 feet in diameter.

The small size of the propellers insures their being completely immersed under all conditions of weather, and it will be further seen by a little calculation that with a normal pitch ratio the slip per cent is not excessive for a vessel of this class at full speed. Mr. Parsons has found that in calculating actual steam consumption per indicated horse power (the resistance of the vessel being known from model experiments) the use of the usual coefficient of 55 per cent ratio of propulsive to indicated horse power gave results which practically agreed with the estimated consumption arrived at by other means, thus proving there was little if any loss of efficiency due to the small diameter of the propellers.

When coming alongside a pier or manoeuvring steam is shut off from the high pressure turbine, the outer shafts only are used, and the steam is admitted by suitable valves directly into the low pressure ahead or astern motors on each side of the vessel.

The center shaft with its turbine under these circumstances revolves idly, its connection with the low pressure turbines being closed by non-return valves. By this arrangement great manoeuvring power is obtained and the vessel is handled just as easily as an ordinary twin screw steamer, taking the piers without the slightest trouble.

While on board the *King Edward* the writer took particular notice of the facilities with which she was handled, both from the point of view of the captain and the engineer, and in either case there seemed nothing that could be desired. In the engine room the engineer has five hand wheels before him. The large one in the centre admits steam to the center high pressure turbine the two lower hand wheels at each side admit steam to the low pressure go-ahead turbines and those above them to the go-astern turbines. When the telegraph rings "stand-by" the engineer has only to give the center wheel a turn or two, thus closing off the steam from the H. P. turbine. He is then ready to receive his next order which may be "full speed astern," in which case it is only necessary to open the go-astern valves by means of the two side upper hand wheels and thus every order is executed by the turning of a couple of hand wheels to the right, say, and a couple to the left or *vice versa*. The whole operation is so simple that one engineer can handle both engines if necessary.

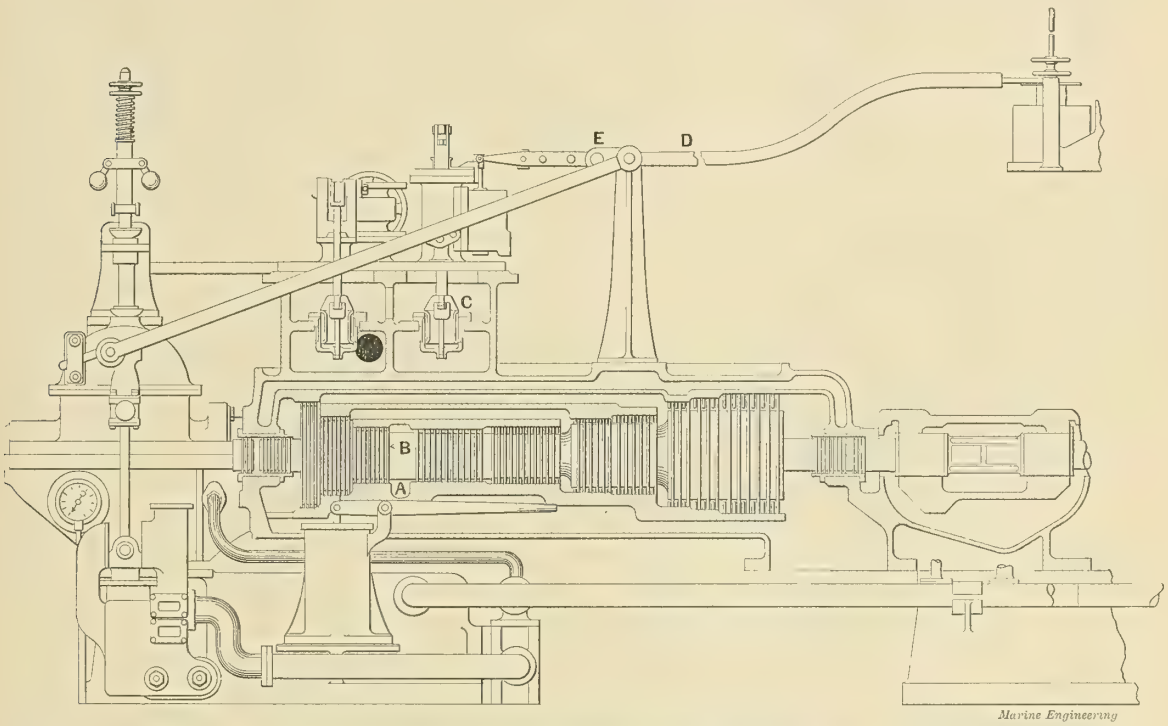
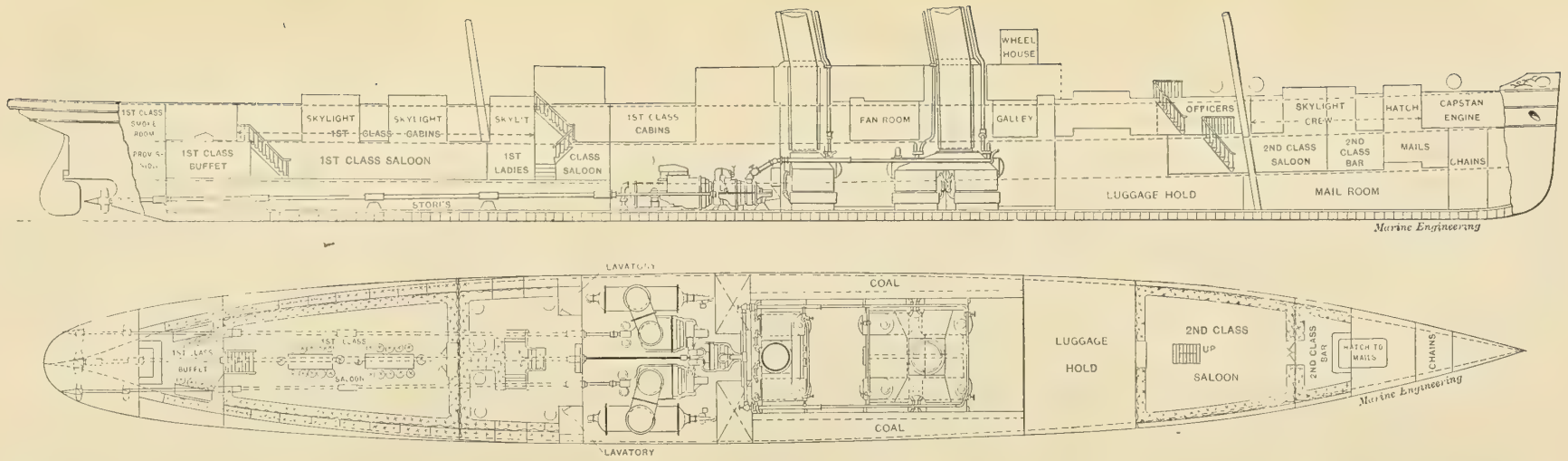


FIG. 2. SECTION OF PARSONS TURBINE SHOWING PATH AND DISTRIBUTION OF STEAM.

The main air pumps are compound and are worked by worm gearing from the main engines. There are also small auxiliary air pumps worked from the circulating engines for draining the condenser before starting. This arrangement seems to the writer unnecessarily complicated and might with advantage be replaced by a pair of the many combined air and circulating pumps on the market.



DESIGN FOR A PASSENGER AND MAIL CHANNEL STEAMER FITTED WITH TURBINE ENGINES. LENGTH OVER ALL 334 FT., ON WATER LINE 320 FT.; BREADTH MOLDED 35 FT.; DEPTH MOLDED 16 FT.; DRAFT 9 FT. INDICATED HORSE POWER 12,000; SPEED 25 KNOTS.

The lubrication is entirely automatic, the oil being continually circulated through the bearings by means of a pump driven by worm gearing. By this means very little oil is used and none wasted, the consumption of oil being much less than in an ordinary reciprocating engine of the same power.

Steam is supplied by a double end Scotch boiler of the usual type, 16 feet 6 inches diameter, and about 20 feet long, having four furnaces in each end, and worked under forced draught by means of closed stokeholds. This boiler with about one inch of air pressure in the stokeholds should give an average of 3,000 I. H. P. with triple expansion engines and good coal.

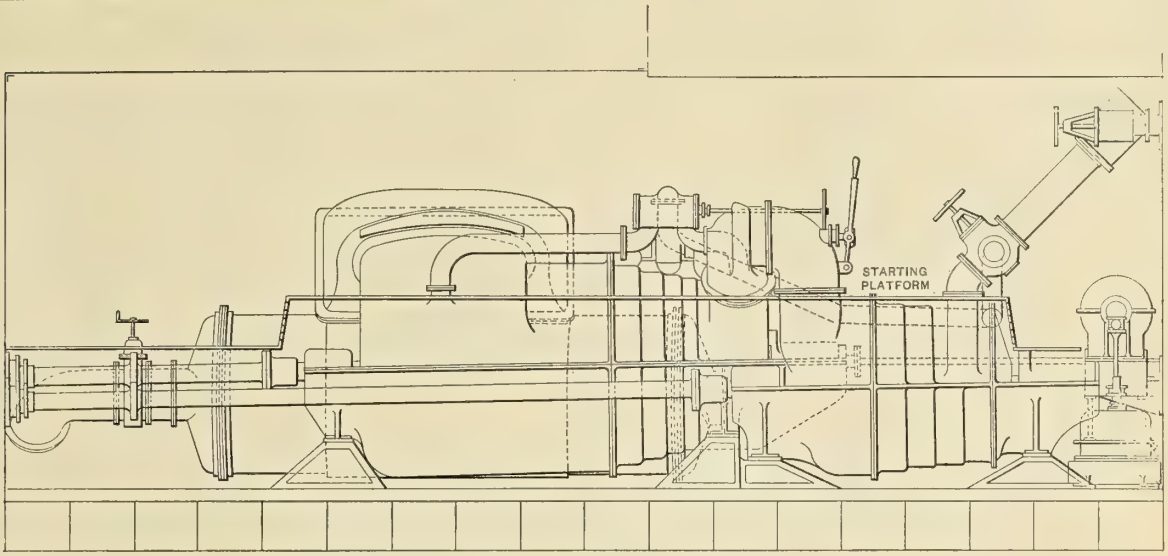
Judging from the speed which the *King Edward* can maintain, her wetted surface and coefficient of fineness being taken into account, it becomes apparent at once that the turbine engine cannot be using more than the usual amount of steam, and indeed the *King Edward* has proved herself a distinctly economical vessel of her class.

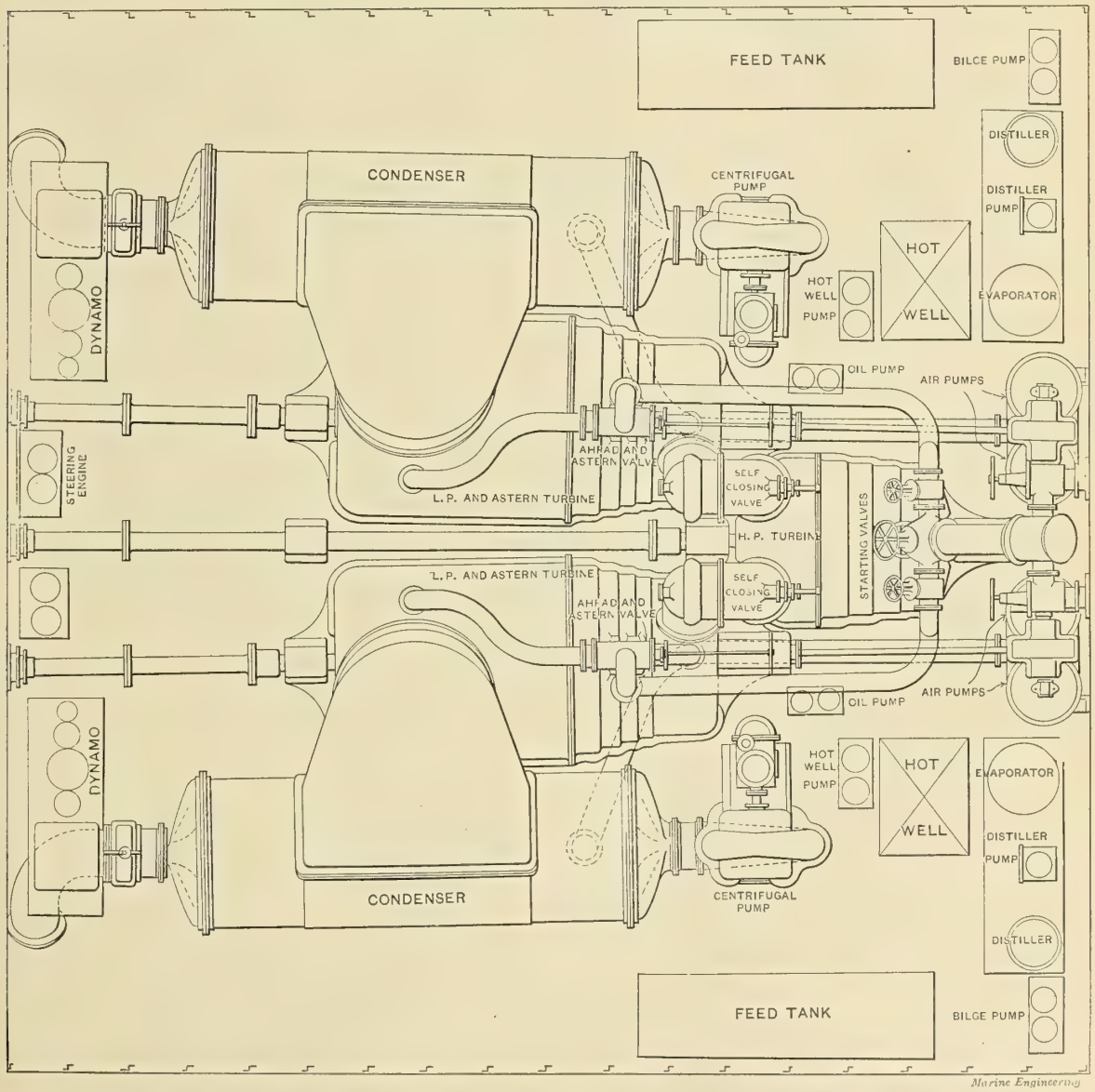
Comparing her with one of the well known Clyde steamers, the dimensions of which are practically the same, she, owing to less weight of machinery and greater available deck space, has a board of trade certificate for 300 more passengers, draws less water, is two knots faster, and burns less coal. Her consumption is estimated at an equivalent of 1.6 pounds of coal per I. H. P. per hour, whereas 2 pounds of coal per I. H. P. may be considered the average consumption for fast paddle river steamers.

The total weight of the machinery in the *King Edward*, including propellers, shafting, condensers, water, etc., is 80 tons, as compared with 200 tons as the weight of compound diagonal paddle engines of the same power. If we take the weight of the boiler and accessories of 170 tons, we get a total weight of machinery and boilers of 250 tons or 12 I. H. P. per ton (of 2,240 pounds.) With very large power and using water tube boilers and superheated steam, Messrs. Parsons claim that it is possible to obtain 16 I. H. P. per ton, this being the case it opens up possibilities of speed in crossing the Atlantic unthought of hitherto.

Another claim made for the use of the Parsons turbine is the absence of vibration. In this respect it is most interesting to note that for two thirds of the length of the *King Edward* taken from the bow, there was entire absence of vibration or noise of any kind, and this also applied to the engine room as far as the main engines were concerned. In the first class saloon which occupies the main deck, from aft of the engine space to the stern, a slight tremor was noticeable, and this, together with a humming noise, was more pronounced in the dining room which was situated under the main saloon and immediately over the propeller shafts. When standing on the counter there was most distinct vibration. This vibration is clearly traceable to the propellers, and was to some extent affected by the position of the rudder.

Taking into consideration the lightness of the hull of the *King Edward* and her comparative shallowness, the writer was forced to the conclusion that in an ocean going vessel of the same comparative speed there would be absolutely no vibration in that part of the vessel where saloon passengers are usually accommodated, namely, above the main deck forward of and around the engine hatch.





ARRANGEMENT OF TURBINE MACHINERY FOR A CHANNEL STEAMER OF 12,000 INDICATED HORSE POWER.

To any one standing in the engine room of this boat who is familiar with the high speed twin screw engine, it at once becomes apparent that the responsibility of the engineer on watch as far as the main engines are concerned is reduced to a minimum. The lubrication is automatic, as already explained, and as there is no pressure on the bearings beyond that due to the weight of the shaft, the likelihood of a hot bearing is almost nil.

During the early days of the turbine there were some unfortunate accidents due to the breaking off of some of the blades, which were then made of cast brass. Since the introduction of blades made from a wire drawn section of brass the breakage of a blade is practically unknown.

Another important point is, that experience has shown there is no deterioration or wear of the blades due to the action of the steam, whether superheated or otherwise, as some turbines in Newcastle have been running 16 hours a day for 12 years, and when examined with a microscope no alteration in the form of the blades could be detected. In practice it has only been found necessary to open up the turbine at long intervals, so that both at sea and in port much less attention will be required than is the case in ordinary engines.

There are what may be considered some minor advantages in the use of the turbine for marine propulsion, not the least of these being that no internal lubrication is required, as there are no rubbing surfaces in contact with the steam. Thus in a vessel where all the machinery was turbine driven there would be no possibility of oil getting into the boilers. The importance of this cannot be over estimated, as every marine engineer very well knows. In addition to this the absence of the necessity for lubrication enables superheated steam to be used at a temperature which would be fatal in the case of the reciprocating engine.

Further, the turbine engine is not affected by priming, the only effect being a temporary reduction of the revolutions, and no serious results would follow consequent upon the breaking of a shaft and the racing of the engines as in the event of the governor not acting promptly and water being carried over from the boiler, the very presence of the water would at once act as a break on the turbine and automatically check the revolutions.

Before concluding, I wish to give some figures which will emphasize the claim for economy made by Messrs. Parson and Co., which claim is the one of vital importance from the shipowner's point of view.

As a turbine engine cannot be indicated, it is necessary to have recourse to some other means of ascertaining the power which is being developed, and the simplest and most accurate of these is the determination of the amount of electrical energy developed by a dynamo when coupled directly to a turbine motor, and working backward from this known data, the I. H. P. necessary to produce this energy can be found.

A turbo-alternator manufactured some time ago at Heaton Works, Newcastle-on-Tyne, for the Corporation of Elberfeld in Germany, was tested by a committee of experts with the following results: At a full load of 1,200 kilowatts (1,610 electrical H. P.) and with a steam pressure of 130 pounds at the engine, and 18 degrees Fahrenheit of superheat, the engine driving its own air-pumps, the consumption of steam was found to be at the rate of 18.8 pounds per kilowatt per hour.

To compare this figure with those obtained with ordinary engines, assuming the highest record of the ration of electrical output to the power indicated in the steam engine, namely, 85 per cent, the figure of 18.8 pounds per kilowatt is equivalent to a consumption of 11.9 pounds per I. H. P.

Now with increased superheat and a more powerful engine, this steam consumption can be still further reduced. Indeed a turbo-alternator of 4,000 H. P. is now being manufactured by Messrs. Brown, Boveri and Company, of Baden, Switzerland, which has been guaranteed to consume not more than 10.2 pounds of steam per I. H. P., the steam pressure being 200 pounds and superheated to a temperature of 180 degrees Fahrenheit above the temperature due to that pressure.

In the face of these figures with engines of several thousand I. H. P. using steam at 200 pounds pressure superheated from 50 to 100 degrees Fahrenheit above the temperature due to the pressure, it is fair to assume an average consumption of 11 pounds of steam per I. H. P.

In last August issue of MARINE ENGINEERING some interesting information was given regarding the *Inchdune* and *Inchmarlow*, pointing out the advantages of superheated steam.

The writer, who has been specially connected with the carrying out of the boiler arrangement on these boats, can vouch for the fact that with Welsh coal it was possible to evaporate from the feed water at the temperature of the hotwell, and supply to the engines at a temperature of 50 degrees above that due to the pressure of the steam at 267 pounds, 11.7 pounds of steam per pound of coal burned under the boilers.

From this, it will be seen that with Parsons turbine engine, together with boilers similar to those in the *Inch* boats, fitted with Ellis and Eaves draught and Central Superheaters, it would be possible to get an equivalent of one I. H. P. on the main engine by the consumption of .94 pound of coal.

Another important matter, from a commercial point of view, is the relative cost of the turbo engines as compared with a high class reciprocating engine. In this respect we have the assurance of the Parsons Marine Steam Turbine Co., Limited, that at speeds of from 15 to 16 knots per hour the first cost of the turbine would compare favorably with the cost of an ordinary engine under similar conditions for the same I. H. P. For higher powers and speeds, turbine machinery would probably cost less than reciprocating engines.

There are many other applications of the turbines on board ship besides that of propulsion which will occur to a marine engineer, but the writer might say that he has recently fitted a turbo fan in connection with the application of Ellis and Eaves induced draught to water tube boilers, and has found it extremely efficient and satisfactory in working, not being affected by the heat of the uptakes and requiring no heavy foundations for support.

THE MECHANICAL EQUIPMENT OF MODERN SCHOONERS.

BY B. C. TUTHILL.

The tendency for the owners of sailing vessels engaged in the coasting trade to increase the size of their ships is induced by several reasons, the principal one of which is the fact that the cost per ton for running the vessel decreases, to a certain extent, as the size of the vessel increases. The gradual increase in size which has been taking place, and which has not yet reached its limit, is rendered possible only by the introduction of improved equipment in the form of mechanical appliances which inevitably forms a portion of the outfit of all large schooners of recent construction.

SIX MASTED SCHOONER GEO. W. WELLS.

(Copyright, 1900, by N. L. Stebbins, Boston, Mass.)

The six-masted schooners *Geo. W. Wells* and the *Eleanor F. Percy*, the two largest vessels of their kind afloat, are engaged in the coastwise trade, making regular runs between Norfolk and Boston, taking from three days to a week to make the passage, depending upon the weather.

The *Geo. W. Wells* is 303 1-2 feet on the keel, 345 feet over all, 48 feet beam, 25 feet depth of hold, and carries 5,000 tons of coal when fully laden. The *Eleanor F. Percy* is slightly larger, being 301 1-2 feet on the keel, 347 feet over all, 50 feet beam, 25 feet depth of hold, and carries 5,500 tons fully laden.

These vessels are fitted out with practically the same equipment and carry a crew, all told, of from fourteen to sixteen men each. Without the mechanical appliances with which these ships are fitted, it would require at least double the number of men they now carry to handle them, and no one would venture to build such vessels without the means at hand whereby the sails, anchors, ropes, etc., could be handled more easily and quickly than by hand.

The *Geo. W. Wells*, which is here selected as a type, is fitted out up to date in every respect, being equipped with two steam winches or hoisters, three steam pumps, a power windlass and capstan, a hand capstan, a steam boiler and a patent screw steerer.

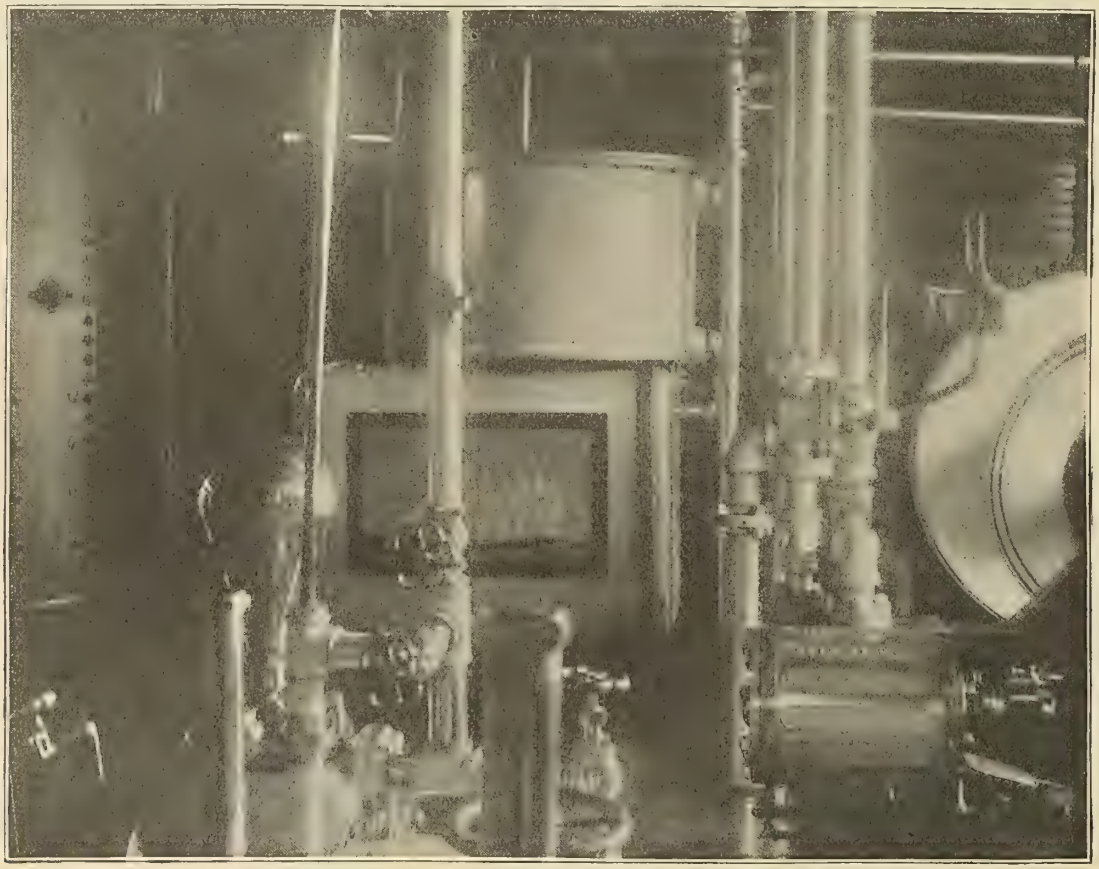
The engine room, which is located on the main deck just abaft the top-gallant forecastle deck, contains the boiler, one steam pump, the larger hoister, besides a feed tank and small condenser. The second steam pump and hoister is located aft on the poop deck, while the power windlass is forward, under the forecastle deck.

The boiler is of the vertical cylindrical type, 54 inches in diameter, 90 inches high, with tubes 5 feet 3 inches long and 2 inches diameter, the working pressure being 120 pounds. This boiler not only supplies steam for all pumps, winches, etc., but also for heating purposes, there being five radiators throughout the ship, three in cabin aft, one in the carpenter's workshop and one in the crew's quarters forward. Besides this, steam is used for heating water for the bathroom aft, and for washing purposes of the crew

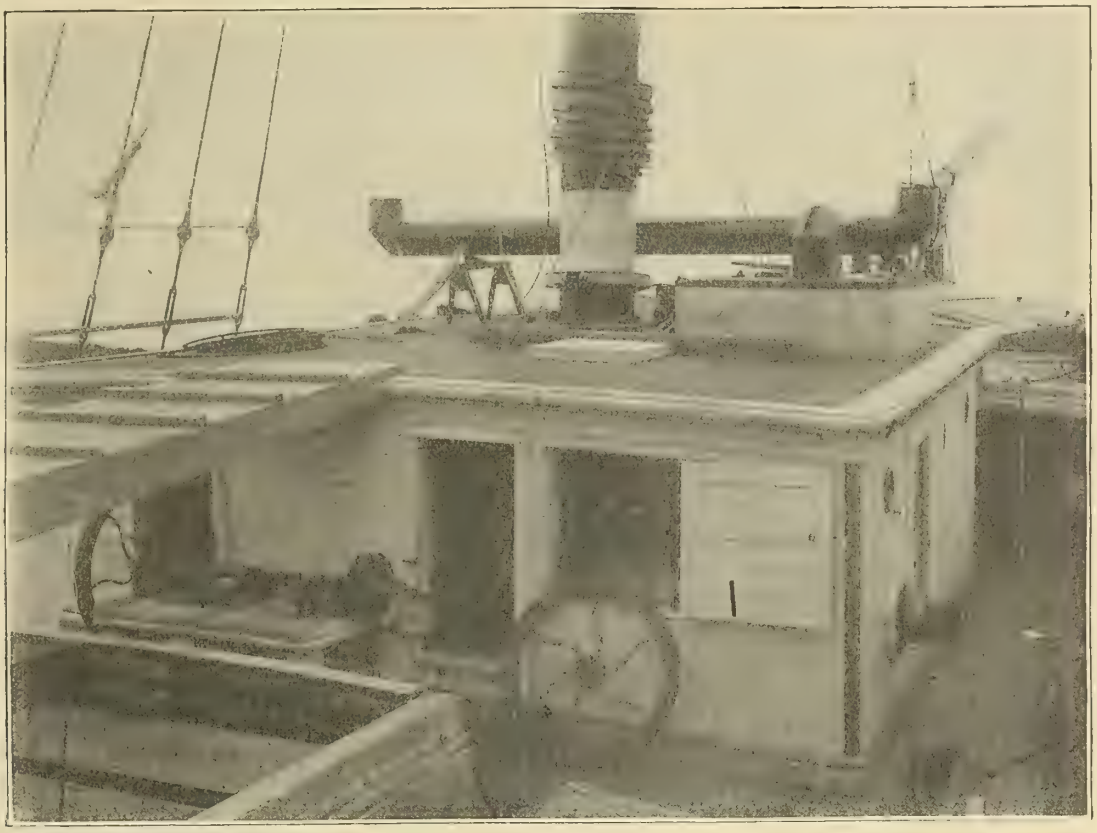
forward. Three pipes are carried aft along the main deck beams, one for steam to the hoister, pump and radiators aft, and one as an exhaust back to the condenser, while the third is a water pipe from the pump. A small pipe is also carried forward under the forecastle deck for heating the wash water for the sailors' use. Steam is kept on the boiler constantly, and in summer it consumes about 2 1-2 tons of coal per week, while in winter, when supplying steam for heating purposes, etc., the consumption runs up to about 5 tons per week. The boiler is seated on a cast iron base forming the ash pan, and securely bolted to the deck, with a layer of cement 3 inches thick between. The uptake is carried up through a square hatch with a heavy plate cover. About four feet above the top of the house it bends to a horizontal, and is carried forward until clear of the foremast, when it branches in a tee and is carried to port and starboard until on a line with the sides of the house, where it ends with a short upward bend.

The pump in the engine room is of the Worthington type, 6 inches by 4 inches by 6 inches, and is used as a service pump, supplying fresh or salt water, also as a circulating pump for a condenser, which is located just above the feed tank. This pump has a 3-inch bilge suction, a 2-inch sea cock and 1 1-2-inch fresh water suction, and can also be used as a feed pump for the boiler in case the two injectors with which it is fitted should fail to operate.

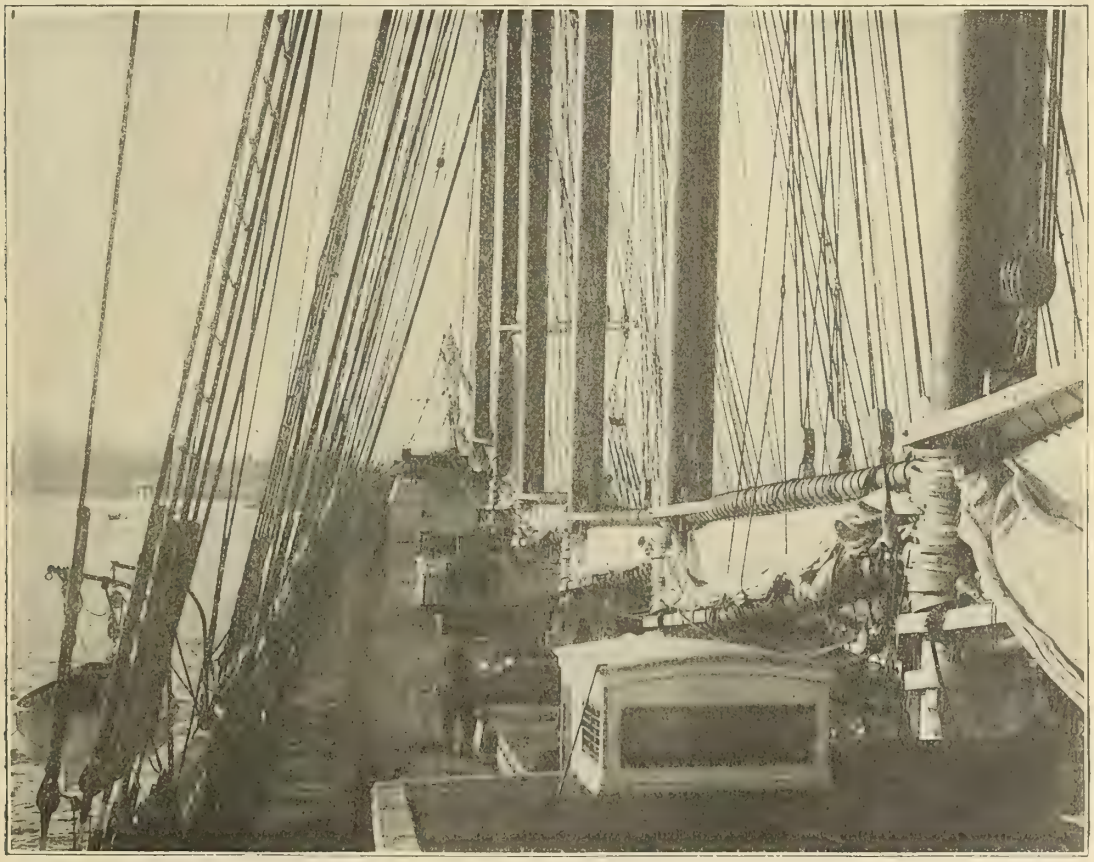
The large hoister, located in the after end of the engine room, is a Hyde, with cylinders 9 inches diameter by 10-inch stroke. The main shaft of this hoister is carried through the sides of the house and large winch heads fitted upon the ends outside. These heads are used in hoisting and handling all the sails on the three forward masts, including the head sails, the sheets, halliards, etc., being led to them by fair leaders or blocks located on the deck. Pull bells are used as a means of communicating signals to the engineer inside. The drum on the hoister itself is seldom used, except in cases where the vessel is compelled to do her own loading or unloading, the docks being usually supplied with the necessary appliances for handling the cargo, especially where coal is carried. Upon the main shaft of the hoister is located a wheel, close to the starboard side of the house, from which a messenger chain runs forward to a counter shaft located outside at the forward end of the house. A second chain connects the opposite end of this shaft with the main windlass, so that by means of a clutch located upon the shaft of the hoister this gear can be thrown in and the windlass operated by means of the hoister. A smaller shaft on the windlass can also be thrown into connection with this gear, whereby the power capstan on the deck above can be operated by the same means. A second wheel and chain is sometimes fitted to the shaft of the hoister for operating the large hand pumps, which, in this case, are located just



INTERIOR OF ENGINE ROOM ON A SIX MASTED SCHOONER.



ENGINE ROOM ON THE FORECASTLE OF A SIX MASTED SCHOONER.

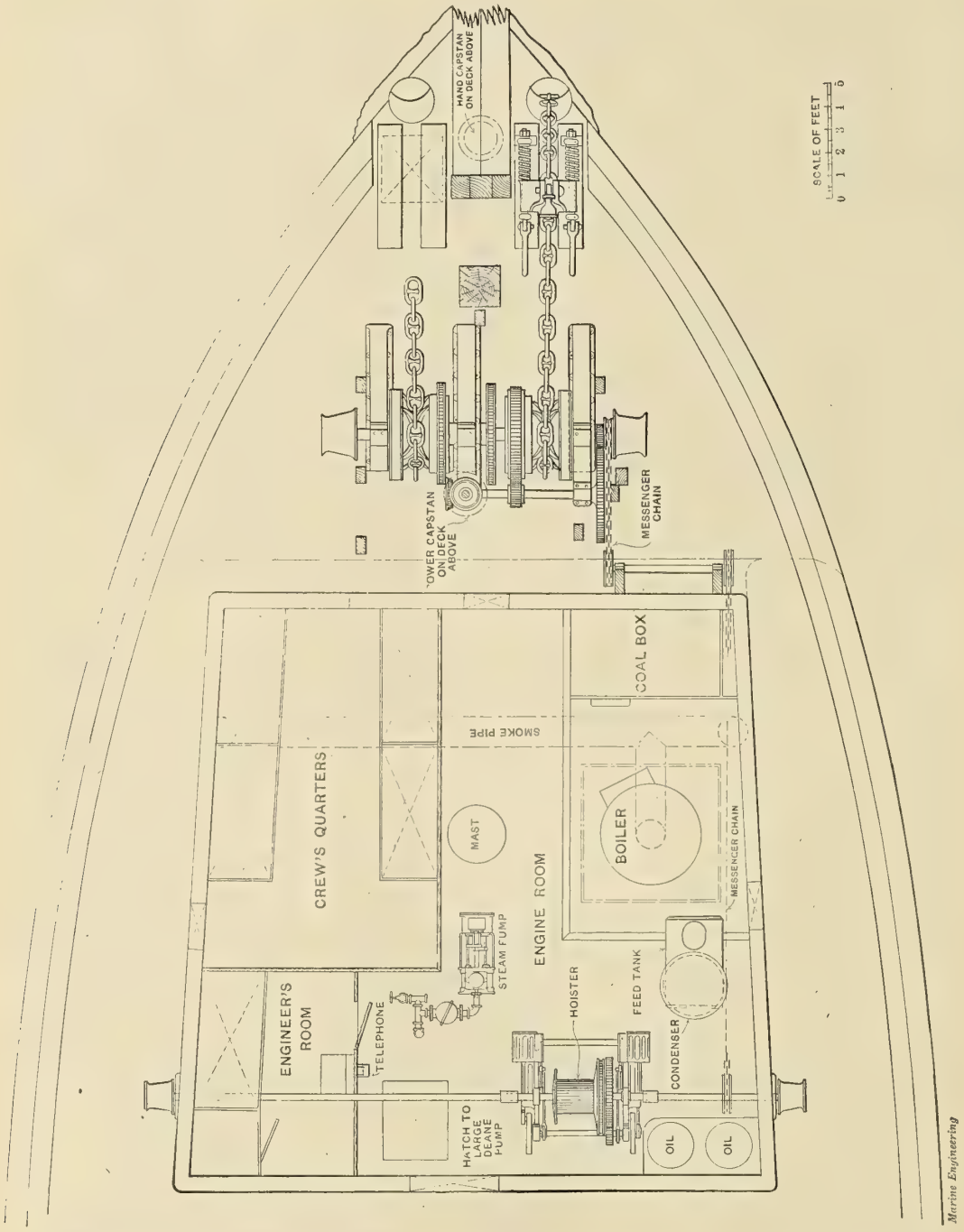


DECK VIEW LOOKING FORWARD ON A SIX MASTED SCHOONER.
(Photo by N. L. Stebbins, Boston, Mass.)

outside the engine room door on the after side of the house.

The main windlass can be operated either by power, as already explained, or by hand from the deck above, the hand gear being thrown in or out by means of a bilge and freeing the vessel of large quantities of water in cases of emergency.

The small steam pump aft is a Hyde duplex, 7 1-2 inches by 8 1-2 inches, by 6-inch stroke, and is located on the main deck at the forward end of the cabin. It



PLAN OF MAIN DECK FORWARD SHOWING ARRANGEMENT OF MACHINERY ON THE GEO. W. WELLS.

lever, which operates a peculiar form of locking device especially designed for the purpose.

Upon a flat below the engine room is located a large single-acting Deane pump with cylinders 12 inches by 12 inches by 12-inch stroke, to be used for pumping is auxiliary to the pump in the engine room, and is used principally in pumping bilges when the ship is down by the stern.

Besides the three steam pumps, the *Wells* has three deluge pumps, each having a 3-inch suction.

The *Eleanor F. Percy* has a Hyde hand pump, located on the poop deck just aft of the small hoister, which can be geared to the hoister by means of a messenger chain similar to the arrangement spoken of above.

The small hoister has cylinders 6 inch by 8 inch stroke, is located on the poop deck just abaft the fifth mast, and is used in handling all the sails on the three after masts. On the *Wells* the topsail sheets and tacks are handled by small hand gypsies located on the fife rail of each mast.

This vessel is supplied with the Hyde Robinson steerer, which has been fitted to most of the large schooners of recent construction. The steerer is a compact form of the double thread screw type, having a shaft with right and left handed threads, supported by two bearings, one being pivoted at the center of the rudder head and the outer or taffrail bearing being supported by wooden chocks on the deck aft of the rudder stock. The cap on the rudder head is made in two parts, and serves the double purpose of a crosshead and a clamp for the rudder stock, being tightened by bolts along the sides. This casting is also provided with a socket, to which an iron tiller may be fitted for use in case of accident. The connecting rods are slightly curved and form a direct connection between the nuts on the shaft and the crosshead, the usual guides being omitted. The taffrail box is in the form of a universal bearing so that it is always in line with the shaft. This prevents any undue friction or strain on the shaft. This bearing is arranged so as to have about three inches lateral play, the shaft being held in the mid position by strong coil springs acting on the ends of the trunnions of the bearing. By this arrangement any sudden shock coming on the rudder is taken up by the springs, avoiding the danger of springing the shaft. With this gear one man is able to handle the ship in all but the worst kinds of weather.

A telephone is fitted on the ship, running aft from the engine room, enabling the officer in charge to communicate directly with the engineer. This is a new departure in the line of schooner's fittings, and will undoubtedly become a part of the regular equipment, as it is found to be a great convenience.

The equipment of different schooners may vary somewhat, according to the size and ideas of the owners or builders, but the *Geo. W. Wells* represents the general method of fitting out practically all the latest built schooners of larger size constructed on the Atlantic Coast.

Erie Basin Fire.—On December 11th fire broke out in the boiler room of the John R. Robbins Company yard, at Erie Basin, Brooklyn, N. Y., destroying the boiler room and much valuable adjoining property to the extent of $100,000.

British Life-Savers.—In the report of the life-savers service on the coast of the United Kingdom for the year ending June 30, 1901, it is recorded that 152 lives were saved on 23 occasions of shipwreck, and that since 1870, 762 lives have been saved. There are at present 314 life-saving stations under the control of this board and no less than 3,770 volunteer surfmen.

The Steamer Hydrographer.

The steamer *Hydrographer*, the latest addition to the surveying vessels of the Coast and Geodetic Survey, has just been completed and turned over to the Survey by the builders, and is now at work in Chesapeake Bay. This neat and efficient little steamer was built by the James Reilly Repair and Supply Company, of New York and Philadelphia, who were the only bidders for the vessel at the amount appropriated. She is 101 feet long, 19 1-2 feet beam, 9 1-2 feet depth, and has a mean draught of 5 1-2 feet when full of coal and water. Her net tonnage is 79.26 tons. For her size she is probably the most efficient steamer afloat, as she carries coal enough to steam 1,600 knots at a speed of 10 knots, and easily makes 11 knots.

The frames are of oak, and planking yellow pine; she is fastened with locust treenails and composition spikes to 1 foot above the water line, and with galvanized fastenings above. All iron used in her construction is galvanized. She is classed A1 for 12 years by the American Bureau of Shipping, under whose inspection she was built.

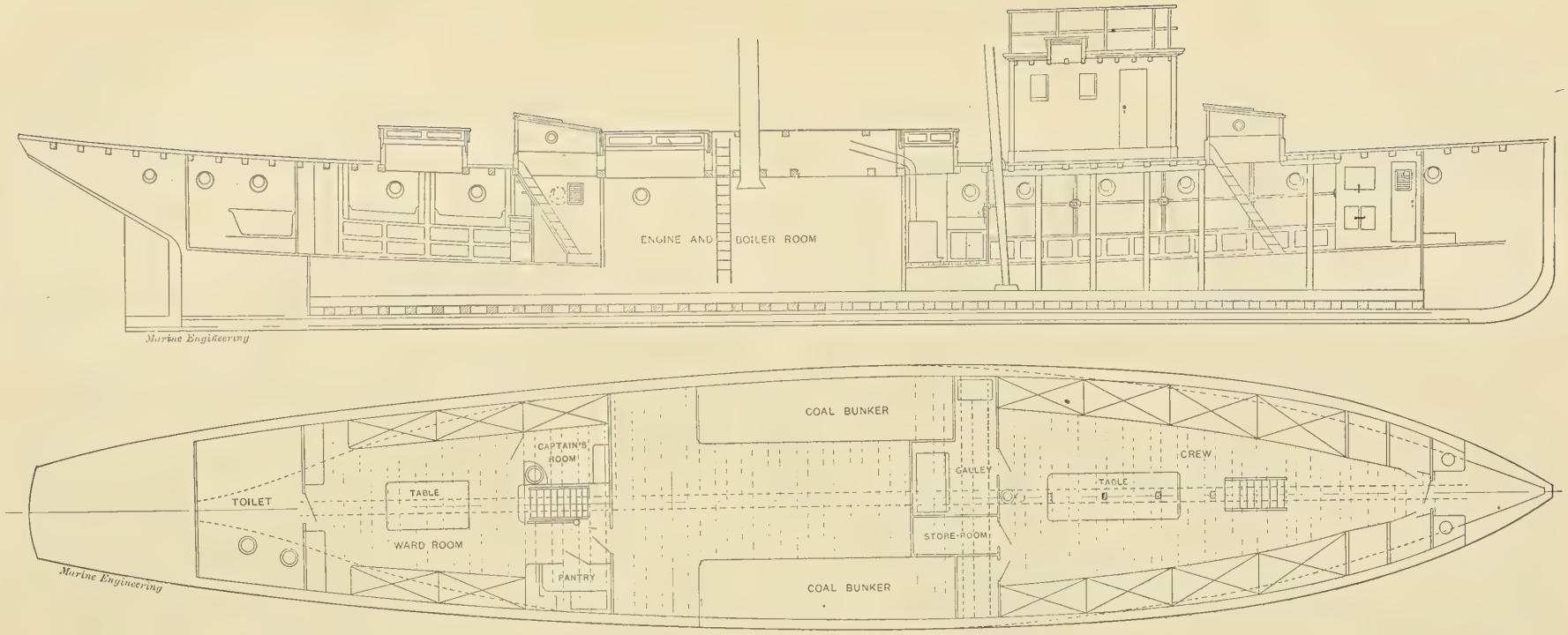
She has a triple expansion engine with cylinders of 9, 13 and 24 inches diameter and 14 inches stroke with Marshall valve gear, and develops 250 horse power. There are independent feed and circulating pumps, fire pumps, and feed pump besides independent feed pump and circulating pump for the evaporator and distiller. The Reilly evaporator has a capacity of 700 gallons of water in 24 hours for the boiler, or 500 gallons capacity for drinking water. The capacity of her water tanks is 2,300 gallons. A boiler of 250 horse power supplies steam at 250 pounds pressure to the engine and 100 pounds pressure to the auxiliaries, all exhaust steam being trapped to avoid a waste of fresh water.

The propeller is four bladed, 4 feet 8 inches in diameter, with 7 feet 8 inches pitch, and made 240 revolutions on the trial trip. When running 10 knots the revolutions are about 200.

The *Hydrographer* embodies some new features for so small a vessel; she carries one 26 foot and one 20 foot whaleboat, and a 13 foot dinghey, all of which stow on deck in heavy weather. As she is liable to be sent through inland waters and canals, guards extend along her sides to protect the boat davits. Baldt stockless anchors of 550 and 750 pounds do duty for the cumbrous anchors and gear usually fitted.

Her complement of five officers and sixteen men have commodious quarters, her berth deck being large, light and well ventilated, and heated by steam, pipe berths allowing a free circulation of air fore and aft. The fittings of the cabin are plain but neat, everything else being sacrificed to comfort and convenience for the hydrographic work for which the vessel was built.

The present work of the vessel is the collecting of data for the correction and revision of the Coast and Geodetic Survey Coast Pilot of Chesapeake Bay and Tributaries, and includes information relating to pilots and where they may be found, best and usual anchorages, depths in the channels, repair and supply facilities, quarantine, harbor and anchorage regulations, and sailing directions. All sailing directions are checked by running the courses with the vessel, and remarks are



ELEVATION AND PLAN OF THE U. S. COAST AND GEODETIC SURVEY STEAMER HYDROGRAPHER.

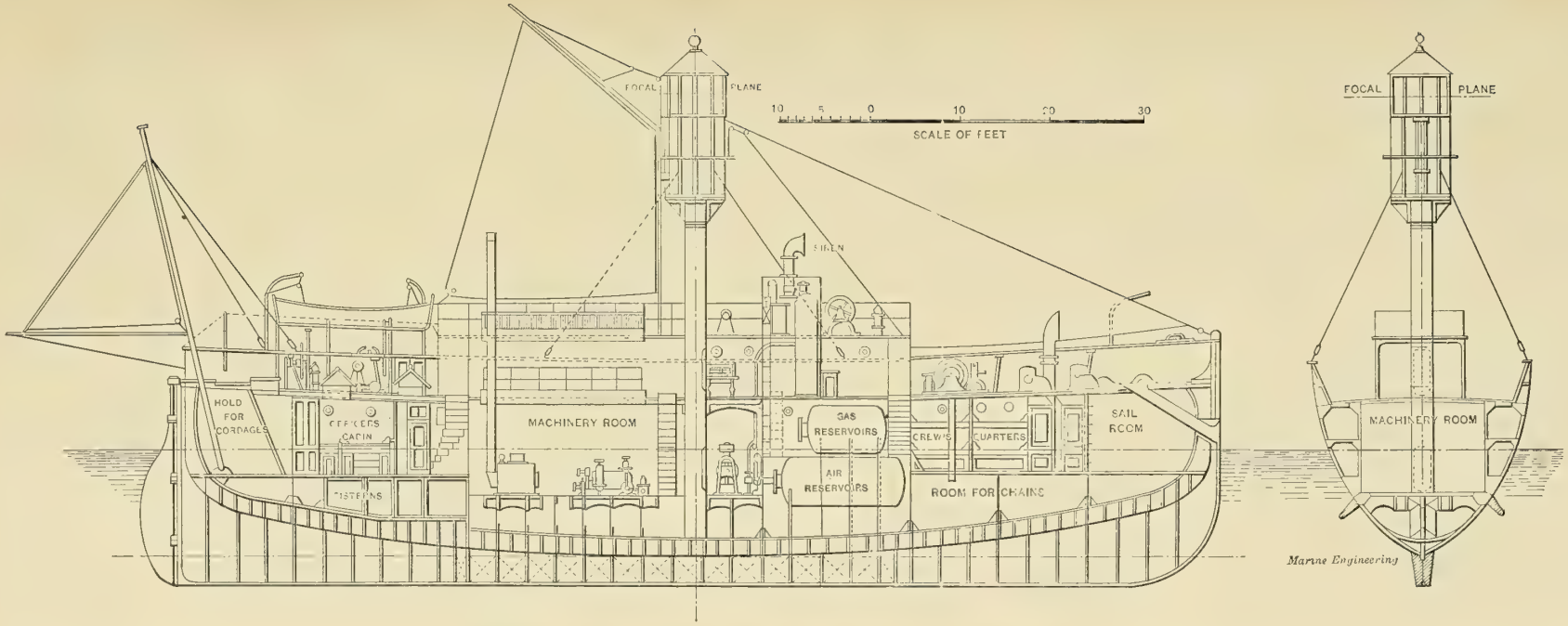
added relating to lights, buoys, and prominent features which may be of use to the navigator. Tables of lights and fog signals, tides, reporting and storm warning display stations, etc., are included, also the available data relating to tidal currents.

In addition to the data collected while on the vessel, any available information in the office at Washington, including the hydrographic and topographic sheets of the latest surveys, and information from the reports of the corps of engineers, U. S. army, are included. State and municipal laws relating to pilots and pilotage, quarantine and harbor control, the storm warning displays of the U. S. Weather Bureau, national quarantine laws and the regulations of the United States Marine Hospital Service, and the International and Inland Rules of the Road are included in the coast pilot appendices.

The *Hydrographer* carries a complete hydrographic party and outfit, and an important part of her work is the surveying of waters like Chesapeake Bay, where there are large shallow areas, for which she is particularly fitted because of her light draught and general handiness. She is also available for surveying work and special examinations in the shallow inland passages which are found along the Atlantic Coast from New York to Florida, and her draught and size permit her to pass inland from the eastern end of Long Island Sound to Ocracoke Inlet, and from Charleston, S. C., to Fernandina, Florida.

Shipbuilding on the Great Lakes.—The American Shipbuilding Company has now under contract 31 ships to be delivered during the next season of navigation.

German Shipbuilding.—Shipbuilding industry in Germany still shows unimpaired activity. In 1898, of the 21 steamships of 10,000 tons or over, then afloat, Germany owned ten, Great Britain six, United States four, and Holland one. This year there are sixty-one vessels of this size, of which twenty-four belong to Germany, twenty-six to Great Britain, six to the United States, three to Holland, and two to France. The contest for speed supremacy in transatlantic passenger and mail traffic has been abandoned by all the companies except those flying the German flag.



SECTIONAL ELEVATIONS OF NEW LIGHTSHIP FOR THE FRENCH COAST.

RECENT IMPROVEMENTS IN THE LIGHTING AND BUOYING OF THE COASTS OF FRANCE.

BY BARON QUINETTE DE ROCHEMONT.

The Lighthouse Department has within recent years inaugurated a new departure in lightship construction. In the first place it was found that the period of oscillation of the waves which materially affects the stability of a lightship, is fairly constant at each side of anchorage. Endeavors were consequently made to diminish the amplitude of oscillation of lightships; 1. By eliminating synchronism between the period of oscillation of the lightship and that of the waves acting upon it. 2. By reducing the rolling produced by the waves, by the addition of side keels to the vessel. This was done in 1890 and 1891, on the Dyck and Ruytingen lightships, of 290 and 338 tons displacement respectively. The period of roll of these lightships has been prolonged to four seconds; whereas the period of oscillation of the waves at the site is two and a half seconds. The period of four seconds has been arrived at by reducing the leverage of the metacenter in cross-section to less than 2.624 feet and also by increasing the transverse moment of inertia by placing pig iron ballast as far distant as possible from the longitudinal axis of the ship. The reduction or rapid cessation of the oscillations is produced by adding three keels to the vessel, the central keel being 3.28 feet deep, and the side keels 2.46 feet deep. The increase of stability thereby obtained is very marked. It has been still further increased by designing the other parts of the ship so that the waves have less effect upon it, and so that a greater force is required to incline the ship to a given angle, than was necessary with former types of lightships. This has been obtained by building recent lightships with a reduced section at the water line, and with a lower center of gravity, the displacement and periods of roll remaining the same, and the ballast consisting of pieces of cast iron attached to the central keel outside the vessel. The draught of the vessels has consequently been very much increased.

These arangements have been tried on two new lightships, the *Talaisand Snouw*, which, being less exposed, could be made smaller than the *Ruytingen* lightship, with 100 tons and 130 tons displacement respectively. The trials made with these vessels confirmed all expectations as to their stability, but they also showed that the *Snouw* was too small to withstand the waves of the open sea. Heavy waves swept its deck; and although they do not affect the vessel's stability, they render the work of the crew very trying.

* Extract from a paper read before the International Engineering Congress, Glasgow, 1901. Section II; Waterways and Maritime Works.

It is proposed, however, to remedy this by lengthening the hull.

The information afforded by these various trials and experiments has been utilized for the design of the lightship which is to be moored on the "Sandettie." These designs have been made by the Central Lightship department, assisted by Mr. Terre, *ingenieur en chef de la marine.* A series of observations taken during these consecutive months, July 11 to October 31, 1900, at the site proposed for the new lightship, show that the motion of the seat at this point is precisely similar to that at the anchorage of the *Ruytingen* lightship, and that the half period of oscillation of heavy waves is about two and a half seconds. The principal dimensions of the *Ruytingen* lightship, which has afforded satisfactory results, have therefore been taken as a basis, and modified, where necessary, in accordance with the results of the observations and experiments referred to above. The main dimensions of the vessel have, consequently, been fixed as follows:

Length over all	114 ft. 10 in.
Width at the water-line	20 " 5 "
Depth from deck to bottom of hold at center	16 " 8½ "
Depth from water-line to bottom of hold at center	11 " 9½ "
Projection of the keel and false keel in the middle	3 " 3 "
Mean draught, when loaded	15 " 1 "
Depth of side keels at center	2 " 7½ "
Displacement	342 tons.

The metacentric leverage transversely is 1.29 feet, and 99.58 feet longitudinally. The hull is divided into six compartments by five water tight partitions across the ship. The two compartments at either end are separated into an upper and a lower chamber by a wooden deck. The compressed air reservoirs for the sounding signal and the gas reservoir for illumination are placed in the third compartment from the bow; the boilers, the machinery for the sounding signal, and the coal bunkers are in the fourth compartment. The crew's quarters are in the second compartment, and the officers' quarters are in the fifth. The latter contains water cisterns of a capacity of 2,200 gallons. The end compartments, fore and aft, are used as storerooms for sails and ropes. The captain's cabin, the chamber for the sounding signal, and the cook's galley are placed on deck amidships, where the gangways leading down to the four central compartments are also situated. The lantern is carried on a hollow iron mast of 2.46 feet internal diameter; access is provided by two doors in the mast—one on the deck level and another in the machinery room. The sails consist of a jib and mainsail, the latter hoisted along an iron upright parallel to the mast, and of a jigger attached to a special mast. There are four anchors: a mushroom anchor weighing 4,400 pounds, two anchors of 1,540 pounds for the catheads, and a cast iron sinker of 264 pounds.

The mooring cables are 1.654 inches in diameter and 984 feet long. Two steel hawse holes are provided in the bulwarks for the sheet anchors. Another cylindrical hawse hole, in the center of the bow, connected with the stem slightly above the water line when loaded, is provided for mooring the ship. Two small lifeboats are provided, 19.68 feet and 18.86 feet long respectively, provided with air chambers.

The illuminating portion consists of a swinging optical apparatus for a lightning-light giving out white flashes at regular intervals of five seconds. The optical apparatus, which has four panels of 9.84 inches focal distance, is provided at the lower part with a rod carrying a counterweight. This rod is fixed by means of a Cardan joint, below the apparatus, in the center of a horizontal ring rolling on steel ball bearings and operated by the rotating machine. Another counterweight is placed at the top of the apparatus. This apparatus weighs 1,540 pounds and is so designed that its center of gravity is 0.591 inches below the point of suspension. Under these conditions, the period of a single oscillation of the apparatus is about eight seconds. The difference between this and a half period of a roll of the ship is such that the divergence of the apparatus from the vertical is less than five to six degrees, and the illumination is not affected thereby. The illuminant for incandescent lighting is compressed oil gas. It is conveyed through a pipe running up the mast, and when it reaches the top it passes through a mercury joint into a small tube, which turns exactly at the same rate as the apparatus by means of a train of wheels operated by the rotating machine. This small tube is connected by a rubber pipe to the lower end of the apparatus, which has a hole running up the center for the passage of the gas to the burner. The illuminating power is 3,500 carcels. The gas is stored in three reservoirs, which are tested at a pressure of 112 pounds; two of the reservoirs have a capacity of 8,240 cubic yards, and the third a capacity of 6,801 cubic yards.

In addition to the illuminating apparatus, the lightship has to be provided with equipment for the sounding signal. This comprises two boilers with distilling plant, condensers, and air compressors; and a single siren worked by compressed air, with reservoirs and accessories. The boilers and condensers are also used for working the steam windlass on board. These boilers are of the type adopted for the 50-horse power engines of scouting or despatch steam launches of the French navy; they have an internal fire box, a direct flame, with forced draught by means of a steam jet into the flue, and a distilling boiler tube. The self-condensers have a single cylinder steam engine, which operates an air pump, two feed pumps, the pumps for the recupérator of distilled water, and the centrifugal pump for maintaining the circulation of the water. The air compressing plant consists of a steam engine working a compressing pump with two pistons and a pump for maintaining the circulation of the sea water. The compressing pumps are designed to work at will, either at a pressure of 210 pounds or at 28 pounds.

The sounding signal is a single note siren, requiring 14.12 cubic feet of air per second; the pitch of the note corresponding to 330 vibrations per second. The rotating machine causes the siren to emit a sound of three seconds' duration, alternating every ninety seconds with a series of three notes, each of three seconds' duration, with intervals of three seconds between each note. There are two reservoirs for storing the necessary air for starting the apparatus instantaneously; they have each a capacity of 10,660 cubic yards, and are tested at a pressure of 210 pounds.

The Sandettie lightship and accessories will cost 340,000 francs.

The crew will consist of a captain and a mate, who will succeed each other on board every alternate fortnight; twelve seamen, eight of whom will be on board and four on land, so that each seaman will in turn spend a month on board and a fortnight on land; and two mechanics to attend to the engines, who will succeed each other on board in rotation every fifteen days.

Protected Twin-Screw Torpedo Boats Siroco and Mistral.

Messrs. Augustin Normand and Company, of Havre, have recently delivered to the French Government, at Cherbourg, two protected torpedo boats, fitted with the same machinery and boilers as the *Cyclone*. The trials offer special interest on account of the very heavy weights carried. The dimensions are: Length on load line, 147 feet extreme breadth outside armor, 16 feet 10 inches. The nickel steel armor extends to the machinery and boiler compartments, and is distributed as follows: Vertical sides from eight inches below the water line to the deck; fore and aft bulkheads from 16 inches below the water line to the deck; vertical sides of coverings of all parts of machinery and boilers, and of the steering engine above deck 24 millimeters (1 inch bare). All horizontal parts of deck and hatchways, 9 millimeters (11-32 inch full). The total extra weight resulting from the addition of armor, including the strengthening of the hull amidship and the addition of a central hollow keel one foot high, extending to about one-half the length of the boats, and intended to stiffen the central part of the structure and to check rolling, is 24 English tons.

The hulls are very strong, as was proved by an accident which occurred to an exactly similar protected torpedo boat in a trial outside Lorient. When steaming at about 23 knots, during foggy weather, she ran end on against a rock rising above water, and although several men were injured by the shock, no material damage beyond the crushing of about 25 feet of the fore part occurred to the boat, which was towed back to harbor.

The total other weights carried on trial, exclusive of chains, anchors, masts, boats, etc., and comprising only torpedo tubes and compressing pump, artillery and ammunition, provisions, water for boilers and crew, coals necessary for steaming 1,020 nautical miles at 14 knots, crew and effects, provisions, including 5 tons for sundries to complete displacement at sea, amounted to 39.9 English tons in the *Siroco*, and 43.2 tons in the *Mistral*. Accordingly, the displacement on trial was 177.5 English tons for the *Siroco*, and 178.7 for the *Mistral*.

The full speed trial, which took place after the ordinary preliminary runs on the measured mile, were of four hours' duration, one hour of which was to be run at 22 knots, one hour at maximum speed, and the next two hours at 22 knots. The one hour maximum speed was found to be 28.341 for the *Siroco*, and 28.102 knots for the *Mistral*. Only 26 knots were required by the contract. The maximum speed of the *Cyclone* (unprotected), with a displacement of 141 English tons, was 30.7.

SHIP SUBSIDY BILL.

On December 9th Mr. Frye introduced in the Senate of the United States the following bill, which was read twice and referred to the Committee on Commerce:—

Title I.

OCEAN MAIL STEAMSHIPS.

SECTION 1. That section one of an Act approved March third, eighteen hundred and ninety-one, entitled "An Act to provide for ocean mail service between the United States and foreign ports, and to promote commerce," be, and hereby is, amended to read:

The Postmaster-General is hereby authorized and directed to enter into contracts, for a term not less than five nor more than fifteen years in duration, with American citizens for the carrying of mails on American steamships between ports of the United States and such ports in foreign countries, the Dominion of Canada excepted, as in his judgment, having regard to the national defense, will best subserve and promote the postal, commercial, and maritime interests of the United States; the mail service on such lines to be equitably distributed among the Atlantic, Mexican Gulf, and Pacific ports. Said contracts shall be made with the lowest responsible bidder for the performance of said service on each route, and the Postmaster-General shall have the right to reject all bids not in his opinion reasonable for the attaining of the purposes named.

SEC. 2. That section three of the Act aforesaid be, and the same is hereby, amended to read:

SEC. 3. That the vessels employed in the mail service under the provisions of this Act shall be American-built steamships, owned and officered by American citizens, in conformity with the existing laws, or so owned and officered and registered according to law; and upon each departure from the United States the following proportion of the crew shall be citizens of the United States, to wit: During the first two years of such contract for carrying the mails, one-fourth thereof; during the next three succeeding years, one-third thereof, and during the remaining time of the continuance of such contract, at least one-half thereof; and shall be constructed after the latest and most approved types, with all the modern improvements and appliances for ocean steamers. They shall be steel-screw steamships, and divided into the following classes according to gross registered tonnage and capacity to maintain at sea in ordinary weather the following speeds:

Over ten thousand tons:

First class, twenty knots or over.

Second class, nineteen knots and less than twenty knots.

Over five thousand tons:

Third class, eighteen knots or over.

Fourth class, seventeen knots and less than eighteen knots.

Fifth class, sixteen knots and less than seventeen knots.

Sixth class, fifteen knots and less than sixteen knots.

Over two thousand tons:

Seventh class, fourteen knots or over.

It shall be stipulated in the contract or contracts to be entered into for the said mail service that said ves-

sels may carry passengers with their baggage, in addition to said mails, and may do all ordinary business done by steamships.

SEC. 3. That section four of the Act aforesaid be, and hereby is, amended to read as follows:

SEC. 4. That all steamships of the first, second, third, fourth, and fifth classes, employed as above and hereafter built, shall be constructed with particular reference to prompt and economical conversion into auxiliary naval cruisers, and according to plans and specifications to be agreed upon by and between the owners and the Secretary of the Navy; and they shall be of sufficient strength and stability to carry and sustain the working and operation of at least four effective rifled cannon of a caliber of not less than six inches, and shall be of the highest rating known to maritime commerce. And all vessels of said five classes heretofore built and so employed shall, before they are accepted for the mail service herein provided for, be thoroughly inspected by a competent naval officer or constructor detailed for that service by the Secretary of the Navy; and such officers shall report, in writing, to the Secretary of the Navy, who shall transmit said report to the Postmaster-General; and no such vessel not approved by the Secretary of the Navy as suitable for the service required shall be employed by the Postmaster-General as provided for in this Act.

SEC. 4. That section five of the aforesaid Act be, and is hereby, amended to read:

SEC. 5. The rate of compensation for such ocean mail service, to be paid per gross registered ton for each one hundred nautical miles sailed from the port of clearance in the United States to the port of entry in the United States, according to the route required by the Postoffice Department, shall not exceed the following:

Steamships of the first class, two and seven-tenths cents.

Steamships of the second class, two and five-tenths cents.

Steamships of the third class, two and three-tenths cents.

Steamships of the fourth class, two and one-tenth cents.

Steamships of the fifth class, one and nine-tenths cents.

Steamships of the sixth class, one and seven-tenths cents.

Steamships of the seventh class, one and five-tenths cents.

The rates of compensation to a steamship to be employed in carrying the mails to a foreign port in North America under any contract hereafter to be made under the provisions of this Act shall not exceed seventy per centum of the maximum rates established by this section: *Provided*, That in the case of failure from any cause to perform the regular voyages stipulated for in said contracts, or any of them, a pro rata deduction shall be made from the compensation on account of such omitted voyage or voyages, and that suitable fines and penalties may be imposed for delays or irregularities in the due performance of service according to the contract, to be determined by the Postmaster-General: *Provided further*, That no steamships so employed and so paid for carrying the United States mails shall receive any other bounty or subsidy from the Treasury of the United States.

SEC. 5. That section eight of the Act aforesaid be, and the same is hereby, amended to read:

SEC. 8. Such vessels shall take, as cadets or apprentices, one American-born boy, under twenty-one years of age for each one thousand tons gross register, and one for each majority fraction thereof, who shall be educated in the duties of seamanship, or engineering rank as petty officers, and receive such pay for their services as may be reasonable.

Title II.

GENERAL SUBSIDY.

SEC. 6. That from and after the first day of July, nineteen hundred and two, the Secretary of the Treasury is hereby authorized and directed to pay, subject to the provisions of this title, out of any money in the Treasury not otherwise appropriated, to the owner or owners of any vessel of the United States duly registered by a citizen or citizens of the United States (including as such citizens any corporation created under the laws of the United States or any of the States thereof), and being at the time of entry engaged in the foreign trade of the United States, which shall be entered in the United States from a foreign port or from any port in the Philippine Islands, compensation as hereinafter provided, that is to say:

(a) On each entry, not exceeding sixteen entries in any one fiscal year, of a sail or steam vessel, one cent per gross registered ton for each one hundred nautical miles sailed.

(b) On each entry, not exceeding sixteen entries in any one fiscal year, and for a period of five years from the date of registration of a vessel of over one thousand five hundred gross registered tons, which shall be completed and registered after the passage of this Act, one-fourth of one cent per gross registered ton for each one hundred nautical miles sailed, in addition to the compensation provided in paragraph (a).

SEC. 7. That compensation under this title shall not be allowed in respect of any of the following-named vessels:

(a) A vessel on a voyage extending only to a foreign port less than one hundred and fifty nautical miles from her last port of departure in the United States or from a foreign port less than one hundred and fifty nautical miles from her first port of arrival in the United States.

(b) A vessel on a voyage less than one-half of the whole length of which, on her outward and homeward voyages, respectively, shall have been on the sea between a port of the United States and a foreign port.

(c) A vessel which shall not be at least of the Class A1, as classified either by the Record of American and Foreign Shipping or the United States Standard Owners, Builders, and Underwriters' Association, or equivalent classification in any other register of shipping of at least equal merit.

(d) A vessel of which less than one-fourth of the crew shall be citizens of the United States or such persons as shall be within the provisions of section twenty-one hundred and seventy-four of Revised Statutes.

(e) A barge, canal boat, or vessel without motive power of its own, or a tugboat, or a vessel engaged in wrecking.

(f) A foreign-built vessel, hereafter admitted to American registry pursuant to the provisions of section forty-one hundred and thirty-six of the Revised Statutes.

(g) A vessel while employed in the coasting trade.

SEC. 8. That the mileage upon which compensation shall be paid under this title shall be determined by the direct customary route from the last port of departure in the United States to a foreign port or a port in the Philippine Islands, and from such last-mentioned port by the direct customary route to the first port of arrival in the United States. If during the voyage the vessel shall enter at two or more foreign ports or ports in the Philippine Islands, the distance by the direct customary route between such ports shall also be included in the mileage upon which compensation shall be paid under this title.

SEC. 9. That any vessel, before receiving compensation under this title, shall have carried, free of charge, the mails of the United States, if the Postmaster-General shall have so required, for the whole or any part of a voyage for which compensation shall be claimed.

SEC. 10. That any vessel, before receiving compensation under this title, shall, when required so to do by the Secretary of the Treasury, carry on each foreign voyage, as a member of the ship's company, one American boy, under twenty-one years of age and suitable for such employment, and one such boy in addition for each one thousand gross registered tons, who shall be taught in the duties of seamanship or engineering, or other maritime knowledge, as the case may be, respectively, and receive such pay as shall be reasonable.

SEC. 11. That the owner of any vessel, before receiving compensation pursuant to this title, shall agree, in writing, that said vessel may be taken or employed and used by the United States for the national defense or for any public purpose at any time; and in every such case the owner of any such vessel so taken or employed shall be paid the fair value thereof, if taken, at the time of the taking; and if employed, shall be paid the fair value of such use. And if there shall be a disagreement as to such fair value the question of the valuation shall be submitted to and determined by three impartial appraisers, one to be appointed by the Secretary of the Treasury, one by the owner or owners of the vessel, and the two appraisers so appointed shall, before they proceed to act, select a third appraiser. The decision of a majority of such board shall be final and effective. In case of any taking or employment, as provided in this section, the shipping obligations of the officers and crews existing at the time shall be deemed to have terminated.

Title III.

DEEP-SEA FISHERIES.

SEC. 12. That from and after the first day of July, nineteen hundred and two, the Secretary of the Treasury is hereby authorized and directed to pay, out of any money in the Treasury not otherwise appropriated, bounties as follows:

(a) To the owner or owners of a documented vessel of the United States engaged in the deep-sea fisheries for at least three months in any one fiscal year, two dollars per gross ton per annum: *Provided*, That at least one-third of the crew shall be citizens of the United States, or such persons as shall be within the provisions of section twenty-one hundred and seventy-four of the Revised Statutes.

(b) To a citizen of the United States serving as a member of a necessary and proper crew of a vessel of the United States documented and engaged in deep-sea fisheries for at least three months during any one fiscal year, one dollar per month during the time necessarily employed in the voyages of such vessel.

Title IV.

GENERAL PROVISIONS.

SEC. 13. That a vessel shal not be entitled to compensation under two or more titles of this Act at the same time.

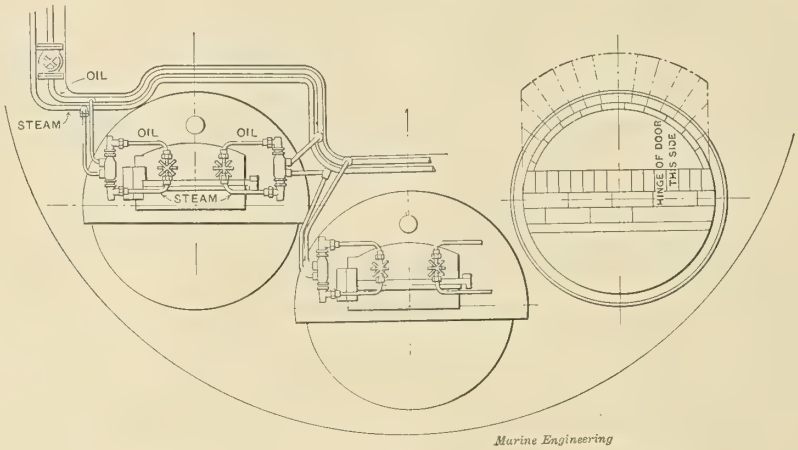
SEC. 14. That a vessel which has at any time received compensation pursuant to any of the provisions of this Act shall not be sold, except by the consent of the Secretary of the Treasury, to a citizen or subject of a foreign power, under penalty of forfeiture.

SEC. 15. That the President of the United States shall from time to time cause to be made, by the proper heads of departments, regulations for the due execution of the provisions of this Act.

Liquid Fuel at Sea.

The use of oil fuel on steamers is being introduced to a considerable extent in Great Britain, the Flannery-Boyd patent system being generally employed. One of the greatest obstacles to be overcome in fitting old steamers with oil burning appliances is making suitable oil tight tanks. Coal bunkers are too light, and the riveting is not oil tight, while the ballast tanks at the ends and in the double bottom would not do because of the water that might leak in. With former systems means have not been used to separate the oil from the water, and a small percentage of water in the fuel causes the flame at the burners to sputter and go out, frequently resulting in an explosion upon relighting. In this system water separation is accomplished in the following manner. Two liquid fuel settling tanks of large capacity and with special arrangements are placed in the 'tween decks amidships immediately adjacent to the boiler room bulkhead. These tanks are fitted with all the necessary heating coils, draining arrangements, thermometers, glass indicators, and other fittings, to enable the liquid fuel to be heated to a sufficient temperature to allow the water being freely separated. Any water which may settle in the bottom of the tanks can at once be drained off. Each tank is made of sufficient size to contain half a day's supply of liquid fuel, so that while the liquid fuel is being used to supply the burners from one tank, the water is being separated in the other. The settling tanks can be filled either direct from the deck or the forward liquid fuel carrying spaces by means of a pump placed in the forward end of the vessel, or from the after ballast tanks or cofferdam, by means of two special pumps placed in the stokehold. The liquid

fuel gravitates from the settling tanks through suitable filtering arrangements, which form an important point in the system, direct to the burners, and is there injected into the furnaces with a spray of steam. Each furnace is fitted with two burners. The furnace arrangements are such that the complete coal-burning gear remains intact, so that either coal or liquid fuel may be resorted to at will. If the vessel is burning liquid fuel, and it is found necessary from economical reasons to resort to coal burning, then it is only necessary to rake some broken fire bricks from off the fire bars, disconnect the burners and light a coal fire. In actual experience this operation can be carried out on a large vessel in less than an hour and without shutting down.

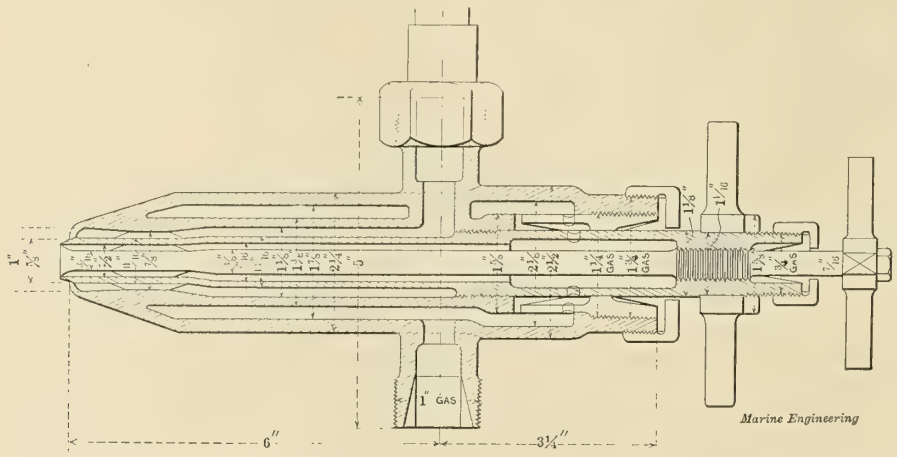


OIL BURNERS APPLIED TO THE FURNACES OF A SCOTCH BOILER.

all boilers. Particular note is to be made of the special feature of the installation whereby coal or oil can be burnt at will, so that an owner may at any part of the world, direct his steamer to use either liquid fuel or coal, whichever he might find most economical.

The Wallsend Shipway and Engineering Company, who have fitted no less than fifty vessels with oil burning apparatus, are now equipping eight more with the system installed on the *Trocas*.

This vessel went on trial recently, and for a number of hours used oil fuel. Afterwards, in order to illustrate how easily the transformation could be made in the arrangements, a change was made to coal without stopping the machinery, the order to discontinue the oil fuel and to adopt coal being carried out in half an hour's time.



DETAIL OF OIL BURNER.

The tank steamer *Trocas* has recently been equipped with this system of oil burners, and as the fuel has a flash point of 200 degrees it is carried in the ballast tanks throughout the ship without conflicting with the requirements of the underwriters or with Lloyds. The *Trocas* is of 4,129 gross tons and is powered by a triple expansion engine and three single-ended boilers, each with three furnaces, and one multitubular auxiliary boiler with two furnaces. Liquid fuel is used with

The departure from the ordinary system in this case was that two burners were used, the ordinary fire bars being also employed, which, on using oil fuel, were covered with broken fire bricks. These, when oil is used, become incandescent and assist very much in the perfect combustion of the fuel. The above facts are taken from *The Engineer*.

Torpedo Boat Goldsborough.

The torpedo boat *Goldsborough*, which was contracted for on July 30, 1897, was completed on December 30, 1898, and since that date numerous attempts have been made to make contract speed on official trials, these, to the present date, have resulted in breakdowns, causing delays. The vessel was overhauled at the navy yard, Puget Sound, Washington, and an unofficial preliminary trial trip was made on November 13th over the prescribed course, on which a speed of slightly over 30 knots was several times attained, the propellers making 340 revolutions per minute. However, one of the blower engines failed to work properly, and this speed could not be maintained. The photograph showing her in normal condition was taken before she started on her trip. Two days later the *Goldsborough* was taken out on the trial which ended

TORPEDO BOAT GOLDSBOROUGH.

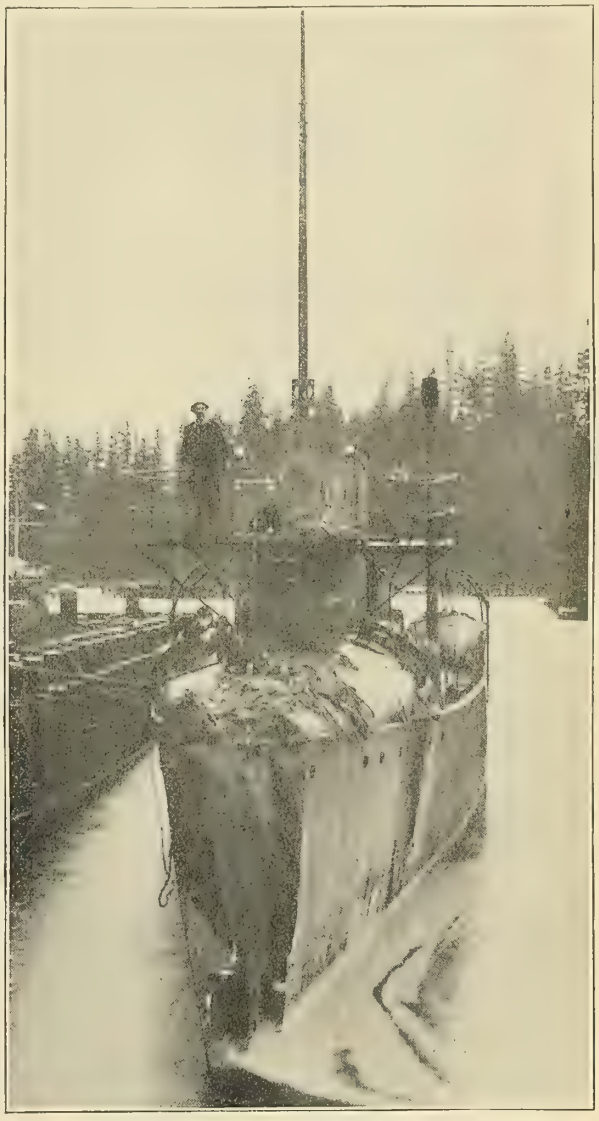
so disastrously. She averaged about 28 knots, the engines not making more than 300 revolutions. It is given out that she failed to make a better speed because of poor quality of coal—a sufficient head of steam could not be obtained. On returning to the yard the boat was steered to make a swide sweep past the regular wharf, and while on this turn she ran head-on into the ordnance wharf, snapping several of the heavy piles like match wood, and crushing in her bows, as shown in the engraving. It was reported that the engine room signals were misunderstood or failed to act.

Robert Fulton Memorial.

On December 5th the American Society of Mechanical Engineers honored the memory of Robert Fulton by unveiling a suitable memorial to this great man over his tomb in Trinity Churchyard, of New York City.

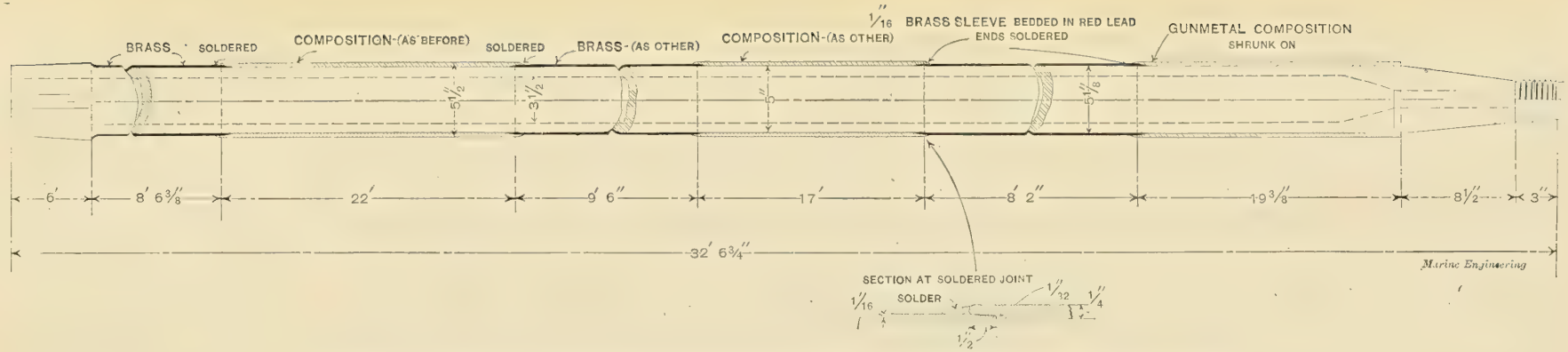
For nearly eighty-seven years the resting place of Robert Fulton has been but barely marked, and yet the engineers of this generation, realizing the important work that Robert Fulton did for civilization, deemed it fit to honor in this wise the great engineer.

Robert Fulton was born in the township of Little Britain, in Lancastershire County, Pa., in 1755, and his early days were spent in studying art and painting, both on this side and in England. His natural tendencies, however, carried him finally into engineering, and in 1793 he published a treatise on canal navigation, and a year later took out a British patent for a double inclined plane for raising and lowering boats from one level to another in a system of canals which he had planned. He also received other patents for mechanical inventions, designed and built an aqueduct and viaduct in England, and as a result of the naval war between England and France of 1797 made elaborate experiments in submarine explosion by means of a torpedo. He also designed a closed boat to navigate beneath



THE GOLDSBOROUGH AFTER COLLISION.

the surface of the water, called the *Nautilus*, which was probably the first submarine boat ever built. A committee appointed by Bonaparte to investigate this invention reported favorably, and the sum of 10,000 francs was granted to conduct further experiments. With this boat Fulton was able to navigate on the surface, and to submerge the boat for thirty minutes at a time. Mechanical propulsion was secured by turning a crank actuating a wheel with elliptical buckets situated at the stern. He made several trips with this boat to demonstrate the feasibility of submarine navigation.



METHOD OF LINING PROPELLER SHAFTS WITH BRASS TUBING AND COMPOSITION TO PREVENT CORROSION.

In 1806, Fulton returned to this country and solicited the aid of Congress. He now devoted his attention to the marine engine, and through the assistance of Robert H. Livingston, the United States Minister to France, bought an engine from Bolton and Watt of Birmingham, England. The world-famed *Clermont* was built in the spring of 1807, and in August of that year this little boat successfully ascended the Hudson River. A grant was obtained from the State of New York, giving Livingston and Fulton the exclusive right of navigating with steam vessels the waters of the State, and they were allowed two years to produce a steamboat of not less than 20 tons burden that should move with or against the tides of the Hudson River at the rate of four miles an hour. The boat was 130 feet long, 16 1-2 feet beam and 4 feet deep. The engine had a steam cylinder 24 inches in diameter by 48 inches stroke; the paddle wheels were 15 feet in diameter. The boiler was 20 feet long, 7 feet high and 8 feet wide. This trip of the *Clermont* demonstrated that it was thoroughly practical to use steam power for propelling vessels. He later designed and built several steam vessels, including a ferry boat and a large war vessel called the *Fulton the First*, which was protected by several of his inventions.

It is not claimed for Fulton that he invented the steamship, but that he gathered together the best engineering material of his day and designed an engine, boiler and vessel on thoroughly practical lines which would meet the requirements of the new service. It is for his mechanical ability and to the service rendered mankind by the demonstration made by his steamboat that the engineers of this day have honored him.

METHOD OF LINING PROPELLER SHAFTS.

A method for lining propeller shafts to prevent corrosion has been used by Mr. Charles D. Mosher with much success on the several small high-speed yachts which he has designed. This system of protecting the propeller shafts has given satisfaction, and the simplicity of construction and application will doubtless recommend it to those familiar with the subject.

The latest shafts which have been so fitted are those on the twin-screw steam yacht *Arrow*, owned by Mr. Charles R. Flint, and described in MARINE ENGINEERING of November, 1900. The shaft, as will be seen by referring to the drawing, is 32 feet 6 3-4 inches long, 5 inches in diameter, with a hole bored throughout its length of 3 1-2 inches diameter, except at the tapered end, where it is reduced to 1 1-2 inches. The shaft is a nickel steel forging furnished by the Bethlehem Steel Company.

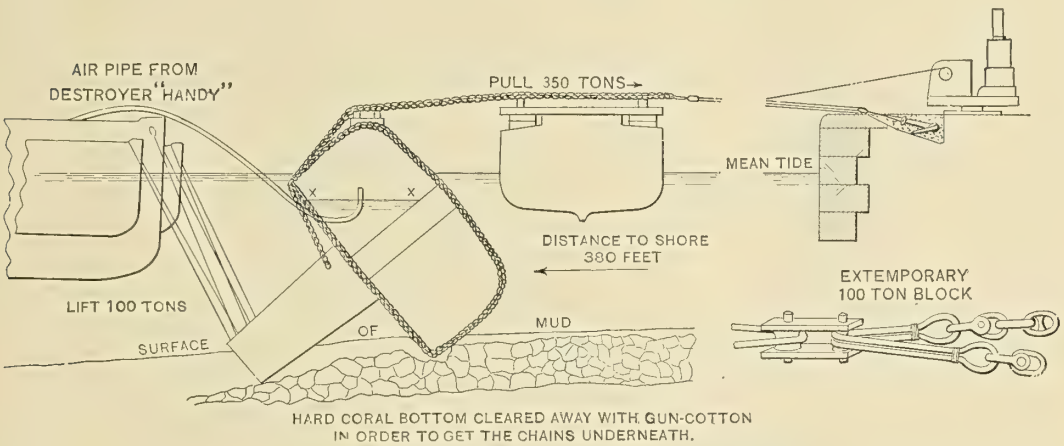
The liner is made up of alternate sleeves of brass tubing of 1-16 inch in thickness, and sleeves of composition 1-4 inch in thickness located on the shaft to agree with the positions of the bearings. As the brass sleeve only serves to protect the shaft from corrosion, it can be made of the lightest metal. The greatest length of any one piece is 9 feet 6 inches. The operation for shrinking on this sleeve was of the simplest character. As will be seen, the shaft should first be placed on V blocks, one end of the shaft being considerably lower than the other, so as to enable water poured in at one end to flow out through the other end of the shaft. The apparatus for carrying out the work consists of a piece of gas pipe (about equal in length to the sleeve to be shrunk on) with a row of holes, perhaps 1-16 inch in diameter, drilled about 5 inches apart. The piece of gas pipe is connected by rubber tubing of convenient length for supplying the gas. It is also preferable to have a supply of air under pressure mixed with the gas for a more intense heat. By igniting the jets throughout the length of this pipe the sleeve may be heated to the desired temperature. It will be seen that this apparatus is very portable and simply constructed. The sleeve can be evenly heated by revolving it over the burner so that it will slip on freely over the shaft, and may be forced into final position by a pair of blocks and tackle secured to a collar placed back of the sleeve, the other end of the tackle being made fast to the opposite end of the shaft.

In practice it has been found that a heat of about 500 to 600 degrees will produce satisfactory results, and this temperature may be measured by placing on the sleeve

small pieces of tin, which will fuse at this temperature. It will be seen that the gas pipe may be carried along the sleeve and thereby prevent the latter from cooling and becoming stuck before reaching the final position, while the shaft may be kept cool by pouring water through the hole, as has been previously stated. The

Turning and Raising a Sunken Dredge.

An account is given in *Marine Engineer* of an interesting salvage feat carried out at Hong Kong. During a typhoon a year ago the dredge *Canton River*, belonging to the Admiralty Docks, foundered and turned bottom up not far from a sea wall. In order to raise

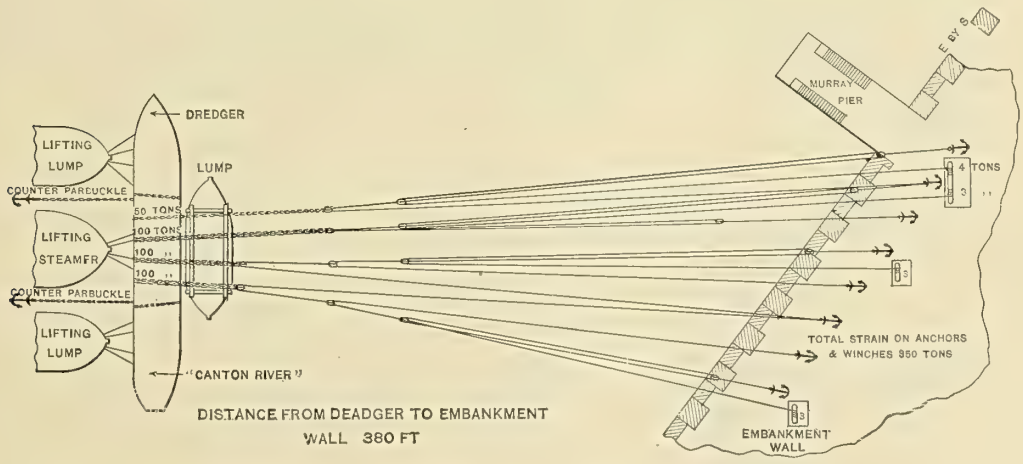


DETAILS OF RIGGING FOR RAISING AND TURNING A DREDGE.

difference in size between that of the shaft and the internal diameter of the sleeve may be arrived at by referring to the tables giving the coefficients of expansion due to the dissimilar metals. As shown in the small detail, the composition sleeves are counterbored to a depth of 1-2 inch, to slide on over the tapered ends of

the dredge it was first necessary to right her, but several attempts proved unsuccessful. Captain Percy Scott, of H. M. S. *Terrible*, then undertook to turn the dredge in the manner illustrated in the accompanying cuts.

Four chains were passed completely around the ves-



ARRANGEMENT FOR RAISING AND TURNING A DREDGE.

the thinner sleeves, while the joint is further made water tight by solder. It is suggested that in order to insure the proper difference of size between the sleeve and the shaft that a small piece of tube a few inches long be first tried, as it will be found that the expansion of the compositions will vary greatly from that given in the usual text books.

sel and secured to the upper deck. The chains were of 1 5-8 inch cable and three of them were double. The other ends were passed over a cradle placed on the bilge, to a barge where the purchases were attached to four parbuckles capable of sustaining a total load of 350 tons. The parbuckles were of wire, and to each was made fast a fivefold Manila purchase.

The leads were taken ashore, one end to a steam windlass, the other to an anchor. In all, eight anchors were used distributing the load over a distance of 100 feet along the sea wall. A strong connection between the parbuckles and purchases was made out of the dredge's spare links as shown in the illustration on page 27.

To prevent the vessel from being hauled toward the shore instead of turning, counter parbuckles were laid and three boats on the opposite side were used as a lift by lashing them to the dredge at low water while they were loaded.

When all was in readiness air was forced into the hull of the dredge until the water had receded to the level XX, and the winches started up, care being taken to produce a uniform pull. The vessel was righted on the bottom without trouble, the upper deck then being in nine feet of water. A cofferdam was built over the hatches, the leaks in the hull stopped and four pumps were soon discharging the water from the hull. She was then pulled along the bottom into shallower water, but a bad leak developed on the port side which admitted more water than the pumps could handle. As there is a longitudinal bulkhead in the vessel, the buoyancy of the two sides was unequal, and she took a decided list, which, with the heavy top weight, caused her to capsize again.

The previous plan of righting was resorted to, though owing to her position the anchors had to be placed on the bottom and the purchases led to another ship. The H. M. S. *Centurion* was anchored for this purpose and a barge with steam windlasses moored to her stern. This time nine anchors and three purchases were used and two of the leads taken to the *Centurion's* capstans, and one to the barge. Again the barge was hauled upright, and six months after the first righting was successfully floated.

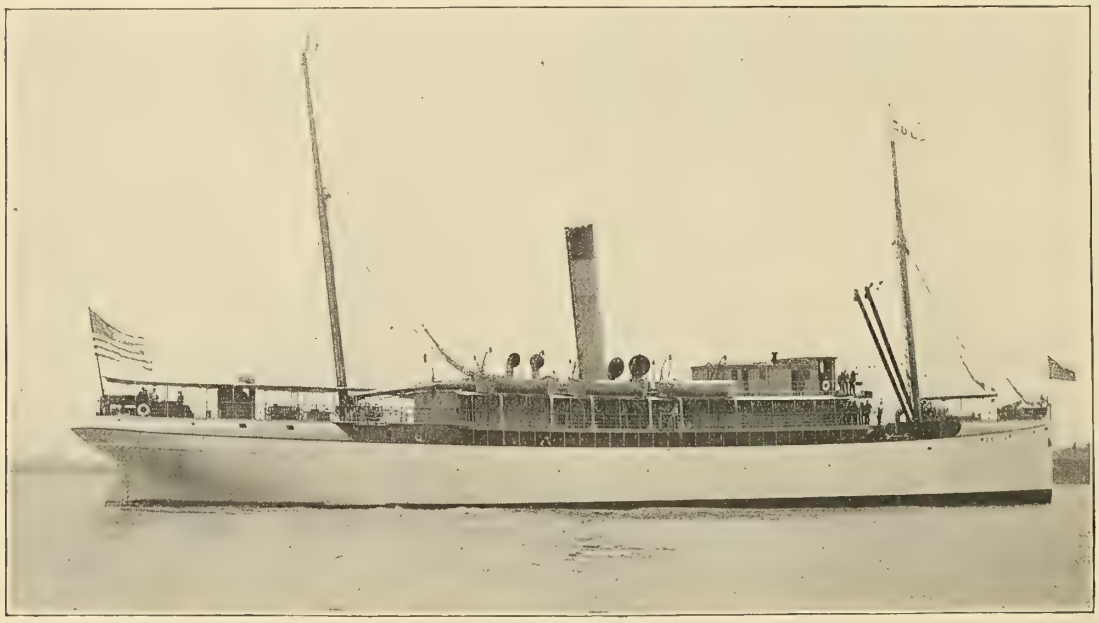
RED D LINE STEAMER ZULIA.

One of the latest additions to our coasting and West Indian fleet is found in the steamer *Zulia* belonging to the Red D Line and built by the Neafie and Levy Ship and Engine Building Company.

The principal dimensions of hull are:

Length over all	277 ft. 6 in.
Length, perpendiculars	266 " 0 "
Beam, molded	37 " 0 "
Depth, "	18 " 6 1/16 "
Depth, at center	19 " 3 3/4 "
Load draft	10 " 6 "
Corresponding displacement	2,144 tons.
Gross tonnage	1,713 "
Net "	1,079 "
Block coefficient	.71
Tons per inch	18.

The outward appearance of the ship as shown in the engraving on this page is very pleasing. She is of the two deck type with poop and forecastle and a two deck bridge house, and is classed under the Record of American and Foreign Shipping. The two steel pole masts are fitted with leg of mutton sails and for handling cargo the foremast has three derricks and the mainmast two. The flat plate keel is 30 inches by 22 1-2 pounds amidship; the frames are 4 by 3 inches by 7 1-2 pound angles spaced 24 inches, and are carried up at the ends to the poop and forecastle gunwale; the reverse frames are 3 by 2 1-2 inches by 5 1-2 pounds; the stern post is of cast steel, and the rudder is of the cast steel plate type bolted to a wrought iron stock.



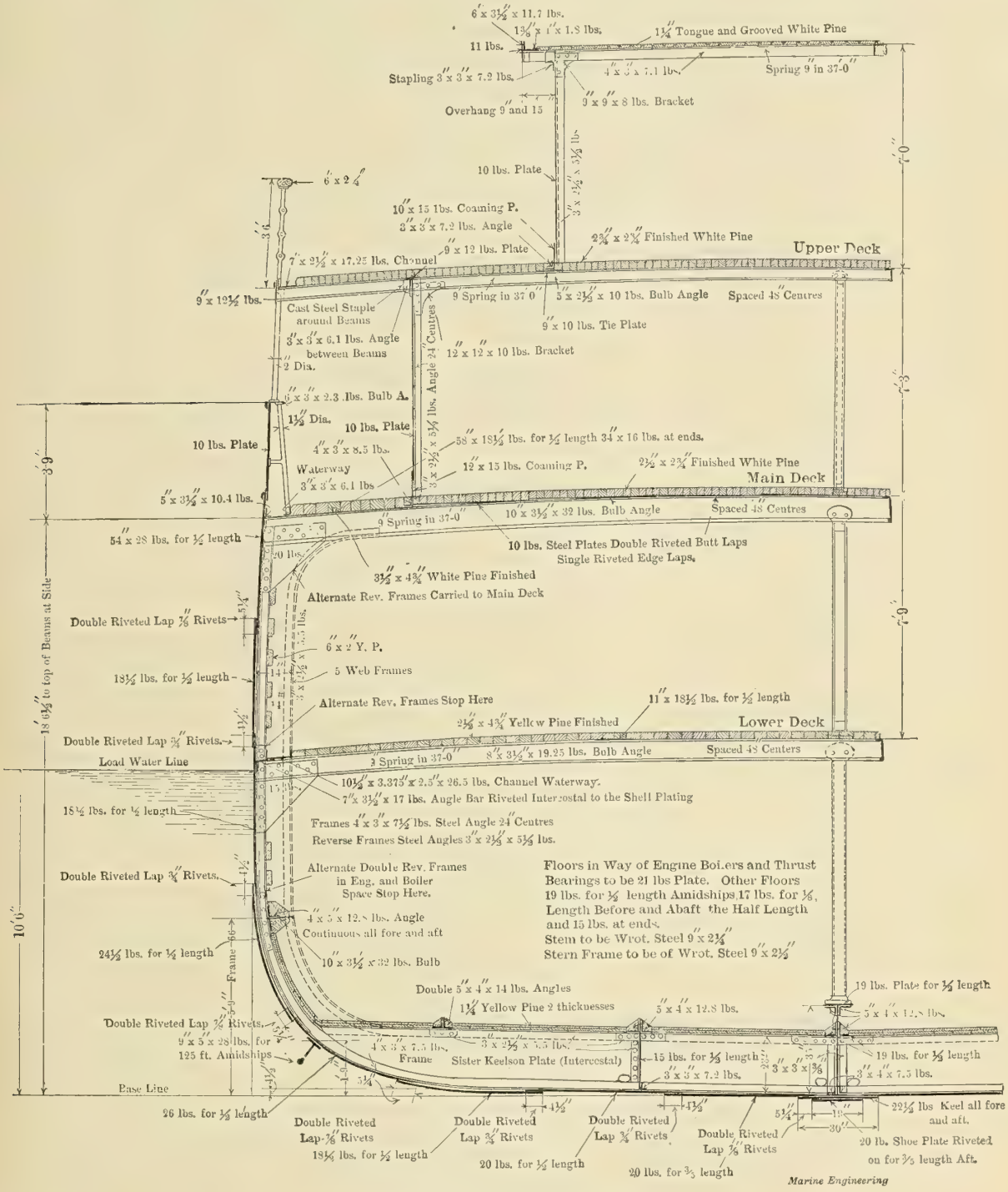
STEAMER ZULIA, FOR THE NEW YORK AND WEST INDIAN SERVICE.

Besides the forward and after collision bulkheads there are four water tight bulkheads extending to the main deck, and there is one aft the engine room up to the lower deck to form a deep tank for use when the ship is in ballast. The main deck is of steel from end to end, planked with white pine, and the lower and upper decks are laid with white and yellow pine respectively. The hold is ceiled with two thicknesses of yellow pine. The details of construction are given in

the cuts of the midship section on page 29, and the inboard profile on page 30.

The forecastle, which is 48 feet long, contains the crew's quarters, a large steward's storeroom, and a

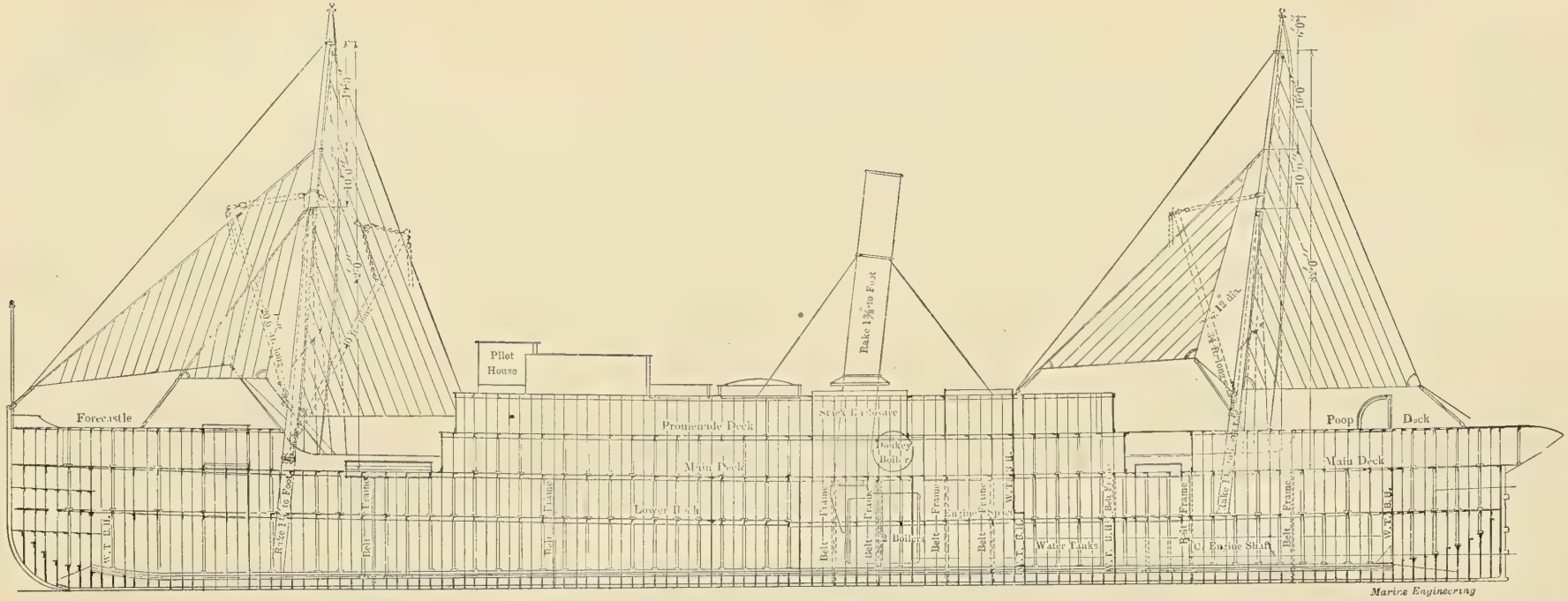
Accommodations for 48 first class passengers are provided in the deck house. The dining saloon and six staterooms are at the forward end, then comes the pantry and galley, storerooms, rooms for stewards,


6" x 3½" x 11.7 lbs.
1⅝" x 1" x 1.8 lbs.
11 lbs.
1¼" Tongue and Grooved White Pine
Stapling 3" x 3" x 7.2 lbs.
4" x 3" x 7.1 lbs.
Spring 9" in 37-0"
Overhang 9" and 15
9" 9" x 8 lbs. Bracket
10 lbs. Plate
6" x 2 4"
10" x 15 lbs. Coaming P.
3" x 3" x 7.2 lbs. Angle
9" x 12 lbs. Plate
2¾" x 2¼" Finished White Pine
Upper Deck
7" x 2½" x 17.25 lbs. Channel
9" x 12½ lbs.
Cast Steel Staple around Beams
9 Spring in 37 0"
5" x 2½" x 10 lbs. Bulb Angle
Spaced 48 Centres
9" x 10 lbs. Tie Plate
3" x 3" x 6.1 lbs. Angle between Beams
12" x 12" x 10 lbs. Bracket
2 Dia.
6" x 3" x 2.3 lbs. Bulb A.
1½" Dia.
10 lbs. Plate
58" x 18½ lbs. for ½ length 34" x 16 lbs. at ends.
10 lbs. Plate
4" x 3" x 8.5 lbs.
12" x 15 lbs. Coaming P.
2½" x 2¾" Finished White Pine
Main Deck
Waterway 3" x 3" x 6.1 lbs
5" x 3½" x 10.4 lbs.
9" Spring in 37-0"
10" x 3½" x 32 lbs. Bulb Angle
Spaced 48 Centres
54" x 28 lbs. for ½ length
10 lbs. Steel Plates Double Riveted Butt Laps
Single Riveted Edge Laps.
3½" x 4¾" White Pine Finished
Alternate Rev. Frames Carried to Main Deck
Double Riveted Lap ⅞" Rivets
6" x 2" Y. P.
18½ lbs. for ½ length
5 Web Frames
Alternate Rev. Frames Stop Here
11" x 18½ lbs. for ½ length
2½" x 4¾" Yellow Pine Finished
Lower Deck
Double Riveted Lap ¾" Rivets.
Load Water Line
3 Spring in 37-0"
8" x 3½" x 19.25 lbs. Bulb Angle
Spaced 48 Centers
10½" x 3.375" x 2.5" x 26.5 lbs. Channel Waterway.
7" x 3½" x 17 lbs. Angle Bar Riveted Intercostal to the Shell Plating
18½ lbs. for ½ length
Frames 4" x 3" x 7½ lbs. Steel Angle 24" Centres
Reverse Frames Steel Angles 3" x 2½" x 5½ lbs.
Double Riveted Lap ¾" Rivets.
Alternate Double Rev. Frames in Eng. and Boiler Space Stop Here.
Floors in Way of Engine Boilers and Thrust Bearings to be 21 lbs Plate. Other Floors 19 lbs. for ½ length Amidships 17 lbs. for ½ Length Before and Abaft the Half Length and 15 lbs. at ends.
Stem to be Wrot. Steel 9" x 2¼"
Stern Frame to be of Wrot. Steel 9" x 2½"
4" x 3" x 12.8 lbs. Angle
Continuous all fore and aft
24½ lbs. for ½ length
10" x 3½" x 32 lbs. Bulb
Double 5" x 4" x 14 lbs. Angles
11¼" Yellow Pine 2 thicknesses
19 lbs. Plate for ½ length
5" x 4" x 12.8 lbs.
Double Riveted Lap ⅞" Rivets.
9" x 5" x 28 lbs. for 125 ft. Amidships
4" x 3" x 7.5 lbs.
Frame
3" x 2½" x 7.5 lbs.
Sister Keelson Plate (Intercostal)
15 lbs. for ½ length
19 lbs. for ½ length
3" x 3" x 7.2 lbs.
3" x 3" x ⅜
3" x 4" x 7.5 lbs.
Base Line
26 lbs. for ½ length
Double Riveted Lap ⅞" Rivets
18½ lbs. for ½ length
Double Riveted Lap ¾" Rivets
20 lbs. for ½ length
Double Riveted Lap ¾" Rivets
20 lbs. for ⅗ length
Double Riveted Lap ⅞" Rivets
22½ lbs Keel all fore and aft.
20 lb. Shoe Plate Riveted on for ⅗ length Aft.
Marine Engineering

MIDSHIP SECTION OF STEAMER ZULIA.

hatch 8 by 8 feet, opening into the forward hold. The main cargo hatch is 15 by 20 feet forward of the deck house. Two winches are at the foremast and located on the main deck and two are at the mainmast on the poop.

engineers and purser, and a large officers' dining room is at the after end. On the promenade deck, which extends from side to side of the ship, are 16 staterooms, a social hall, lavatories and smoking room. The chart house and officers' quarters are on the hurri-



LONGITUDINAL ELEVATION OF THE STEAMER ZULIA.

cane deck where also the boats are carried.

Thirty-two passengers can be carried in the second cabin, which is built in a house under the poop deck. There are eight large rooms and commodious lavatories. Two refrigerators are at the after end of the poop.

The propelling power of the ship consists of two sets of three cylinder, triple expansion, inverted, direct acting engines. The cylinders are 14, 21 and 36 inches in diameter by 26 inches stroke. Stephenson link motion operates the valves, two of which are slide valves and the third, the high pressure, is of the balanced piston type. The bedplate and rear columns are of cast iron, while steel columns support the cylinders at the front. A condenser, common to both engines, with cast iron shell is located at the after end of the engine room above the thrust bearings. It is fitted with 3-4-inch tubes, giving a cooling surface of 2,200 square feet. The main pumps are as follows. One vertical air pump, 7 1-2 by 15 by 10 inches; one main feed pump, vertical, 6 by 4 by 7 inches, a horizontal 5 1-2 by 5 by 6 inch bilge pump, and a centrifugal circulating pump with a runner 28 inches in diameter. The first three named pumps are of the Blake pattern. A feed water heater made by the shipbuilders is fitted.

The rear ends of the two Scotch boilers project through the forward engine room bulkhead. Each boiler is of the following dimensions:

Length	12 ft. 8 in.
Diameter	12 " 3 "
Number of furnaces	3
Diameter of furnaces	3 " 9 "
Length of grate	6 " 6 "
Number of tubes	206
Size of tubes	3 "
Heating surface	1,840 sq. ft.
Grate surface	63 " "
Height of funnel above grates	67 ft.
Steam pressure	160 lbs.

There is also a cylindrical donkey boiler 9 feet long by 7 feet in diameter. Coal is carried in wing and thwartship bunkers with a capacity of 322 tons.

The propellers are of cast iron, 9 feet diameter and 11 feet 6 inches pitch, with four blades. The propeller shafts are 7 1-2 inches diameter and the line and thrust shafting 7 1-4 inches.

At the load draft of 10 feet 6 inches the *Zulia* can make 12 knots, and at this speed the engines are turning 140 revolutions a minute and developing about 1,200 indicated horse power.

NAME—Zulia. NATIONALITY—American. TYPE—Coaster.

LAUNCHED—1901. BUILDER—Neafie & Levy S. & E. Bldg. Co.

Length between perps.	266 ft. 0 in.	Designed R. P. M.	140
Length over all	277 " 6 "	" I. H. P.	1,200
Beam molded	37 " 0 "	" Speed	12 knots.
Depth to main dk. molded	18 ft. 6 1-2 in.	Condens. surf.	2,200
Draft, loaded	10 ft. 6 in.	**Boilers,** number	2
Displacement	2,144 tons	Type	S. E. Scotch.
Dead wt. capacity	1,713 net tons.	Pressure	160 lbs.
Block coef.	.71	Length	12 ft. 8 in.
Bunker capacity	332 tons.	Diam.	12 " 3 "
Propellers, No. blades	4	Furnaces in each	3
Diam.	9 ft.	Diam. furnaces	39 in.
Pitch	11 ft. 6 in.	G. S. total	126 sq. ft.
Material	Cast iron.	H. S. "	3,680 " "
Engines, number of	2	Draft	Natural.
Type	3 cyl. triple.	H. S. + G. S.	29.2
Cylinder diam.	14, 21, 36	H. S. + I. H. P.	3.07
Stroke	26	I. H. P. ÷ G. S.	9.52

LAUNCHES.

Schooner Kenwood.—The four masted schooner *Kenwood* was launched from the yard of William McKie, of East Boston, on November 27th. She is of 900 gross tons, 184 feet 6 inches long, 37 feet 4 inches beam and 18 feet 4 inches deep. She is built largely of white oak and live oak, and the ceiling and planking are of Georgia yellow pine in extra long lengths. The lower deck is of yellow pine; the upper deck is of white pine.

Steamer Eastern States.—On December 8th the steamer *Eastern States*, of the Cleveland and Buffalo Transport Company, was launched from the Wyandotte yards. The dimensions of the steamer are: 386 feet length over all, 365 feet on the water line; breadth of hull, 45 feet; breadth over guards, 80 feet; molded depth, 20 feet; draught, 12 feet; coresponding displacement, 3,400 tons. This ship is designed for fast night-passenger service between Detroit and Buffalo. The vessel will be driven by a horizontal triple expansion engine of 5,000 horse-power actuating feathering paddle wheels 25 feet in diameter. Scotch boilers will be equipped with the Howden system of forced draft.

Steamer Frank W. Osborne.—On November 16th there was launched from the Lorain yard of the American Shipbuilding Company the steamer *Frank W. Osborne.*

Schooner Mary Barrett.—The schooner *Mary Barrett* was recently launched from the yard of Gardner G. Deering, Bath, Maine, and is of the following dimensions: Length, 241 feet 5 inches; beam, 43 feet 4 inches; depth, 27 feet 8 inches.

Schooner Miles M. Merry.—The four masted schooner *Miles M. Merry* was recently launched from the yard of Percy and Small, Bath, Maine. The dimensions are: Length, 205 feet 3 inches; beam, 43 feet 2 inches, and depth, 20 feet.

Steamship Merion.—The new twin screw steame *Merion*, built for the International Navigation Company, was recently launched from the Clydebank yard of John Brown and Company, Scotland. She is a sister ship to the *Haverford*, described and illustrated in MARINE ENGINEERING of July, 1901.

Passenger-Propeller Calvert.—The Neafic and Levy Ship and Engine Building Company, of Philadelphia, Pa., launched from their yard on November 23d the passenger propeller *Calvert* belonging to the Weems Line. The vessel is 190 feet long, 40 feet beam, 12 feet deep, is driven by compound engines 20 and 40 inches by 28 inches, supplied with steam by Scotch boilers 14 feet 9 inches in diameter, and 12 feet long.

Towboat Vesta.—The first steel hull vessel built by James Rees and Sons' Co., Pittsburg, Pa., was launched from their yard on December 5th. The vessel is a towboat built for the Vesta Coal Company for towing coal barges on the Ohio. The length of this steamer, which is christened the *Vesta*, is 135 feet, the beam is 24 feet over guards, the hold is 4 feet 6 inches deep. The propelling machinery consists of two compound engines driving a stern wheel.

Steam Yacht Isis.—At the yard of Messrs. T. S. Marvel and Company there was launched on December 10th the steam yacht *Isis*, owned by Messrs. W. S. and J. T. Spaulding, of Boston. The *Isis* is a twin-screw steamer; length over all, 200 feet; length on water line, 164 feet; beam, 24 feet 6 inches, and draught, 11 feet 6 inches. She will have two Yarrow water tube boilers with forced draft, and the engines will be triple expansion, with cylinders 12, 18 1-2 and 29 inches in diameter by 20 inches stroke. The yacht will be towed to Hoboken to receive her engines to be furnished by W. and A. Fletcher Company.

Monitor Florida.—The United States monitor *Florida* was launched on November 30th from Lewis Nixon's shipyard, at Elizabethport, N. J. The *Florida* is 252 feet long, 50 feet beam; mean draught, 12 feet 6 inches; displacement, 3,235 tons with stores on board, and at normal coal supply. The ship is to have a speed of 11 1-2 knots, driven by twin screw vertical triple expansion engines, indicating 2,400 I. H. P., supplied with steam by modified Normand boilers. The sides are protected by continuous belts of armor 5 1-2 inches thick below the water line and increasing to 12 inches at the water line. The armament consists of two 12-inch guns, placed in single turret with 12-inch armor mounted en barbette, forward. There are four 4-inch rifles and a secondary battery of ten small guns.

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Notice to Advertisers.

Changes to be made in copy, or in orders for advertisements, must be in our hands not later than the 15th of the month, to insure the carrying out of such instructions in the issue of the month following.

IN the present session of Congress two movements are already under way fraught with the greatest importance for the merchant marine and for the general shipping interests of the country. These are the new shipping bill introduced by Senator Frye, and the movement toward an Isthmian canal, which is now attracting so much attention both in Congress and from the country at large.

Regarding the shipping bill, the details of its provisions will be found on another page of our present issue and need not be repeated here. The main provisions are two in number, the first providing for a readjustment of the payments for the carriage of ocean mails, and the second providing for a general subsidy for all vessels, steam or sail, which are not under mail contracts.

The question as to whether special contracts with vessels carrying the mails and a general subsidy for vessels of all other classes is the best method of building up the merchant marine, is a question for the political economist, rather than for the engineer, and we shall not consider it our duty to discuss in these columns those phases of the question which are more especially political in character. If, however, the general policy outlined in the bill is to be considered as suitable for the purpose in view, and there seems to be abundant precedent for such policy in the legislation of other maritime nations, then we may properly consider the adequacy of the bill as proposed for the purpose to be attained, and we may properly compare the present bill with that proposed at the last session of Congress.

The first section of the bill provides for a complete readjustment of the ocean mail contracts, and is in effect a series of amendments to the ocean mail act of 1891. The general purpose of these amendments is to free the United States postal service of dependence on foreign ships for the carriage of its mails, and to substitute throughout an American system. The new classification of ships in seven classes instead of four is in accord with the modern progress of ship building, and the readjustment of rates of pay is based on the experience of the past ten years with the act of 1891. The rates thus fixed by the bill are the maximum, and the contracts will be open to competition, and awarded as much below the maximum as will secure an American service.

These features of the bill are great improvements over the act of 1891, and should command most careful consideration. While it is desirable that the products of our mills and farms should be carried to our foreign purchasers in American ships, it is perhaps still more desirable that in the carriage of our mails we should be independent of foreign ships, and especially of such as are enrolled on the list of foreign auxiliary cruisers. The most important questions which may be asked in this connection are two: Will the foreign mail service for a time suffer any serious loss of efficiency? And, is the compensation offered sufficient to induce adequate capital to enter the field and provide a service which shall be adequate to the needs of the business world? If the public can be satisfied on these two points, and if at the same time it shall appear that the compensation is only fair for the services rendered, then it is perhaps likely that this section will commend itself widely and irrespective of the specific question of the subsidies provided in the second title of the bill.

This section provides for a general subsidy for all vessels, steam or sail, which are not under mail contracts, and is uniform at one cent per gross ton per 100 nautical miles for not exceeding sixteen entries in one year. The purpose of

this payment is intended to equalize the difference in the cost of building and operating ships in the United States and in Europe. It is just at this point that the chief difficulty in carrying out the principle of the subsidy is found. It is intended to equalize a difference, but as we took occasion to point out in our last issue, no one knows just what this difference is, or what it should be under fairly equal general conditions. Many are opposed to the principle of a subsidy because they believe that this difference is more fancied than real, and in any event that the difference is not as great as the subsidies proposed, and they are opposed on principle to the payment of a premium to any man simply for engaging in one kind of business rather than another. The American ship owner is, of course, the first to agree with his critic in this regard. He does not wish to be made an object of charity, and would be the first to resent such an imputation. He only asks such aid as will make possible at a fair profit the operation of shipping under the American flag in the commercial carrying trade of the world. And thus the trouble arises in satisfying the public at large that this difference is a reality, and that it is not due to the fault of the American shipbuilder, and that the subsidy proposed is not enough more than this to constitute a substantial premium simply for carrying on a shipping business. We would still question whether the information available regarding the items going to make up this difference is sufficiently detailed, accurate and comprehensive, so that all concerned can be safely assured that the figures proposed will be adequate without being excessive. The difficulties in the case seem to arise largely from the uncertainties in the situation, and from the difficulty in devising any system of compensation which shall meet without exceeding the requirements of the situation, and which shall be reasonably permanent for a term of years in equalizing the differences referred to. If the general public could be satisfied that the present bill could be depended on to fulfil these conditions, doubtless much of the opposition which was directed against its predecessor would be withdrawn. In any event it seems fair to believe that the present bill is free from many of the objections which were urged against its predecessor, and that in its general features it is well adapted to utilize the principle of the subsidy for the relief of American shipping.

Regarding the Isthmian canal, the recent ratification of the proposed treaty with Great Britain and its undoubted acceptance by the latter power leaves the way clear for the early consideration and passage of a canal construction bill. It seems fair to believe that there is a very generally distributed desire on the part of the American people for such a canal, and it would seem to be the duty, as we believe that it will be the pleasure of Congress to unite irrespective of party on a measure which shall secure an early construction of the canal and the benefits which it seems calculated to bring.

THE findings of the court martial which was called to investigate the circumstances connected with the foundering of the British torpedo boat destroyer *Cobra* have been made public, and the verdict is, in effect, that the *Cobra* broke in two near amidships, such rupture having been due to insufficient longitudinal strength. This finding is entirely in accordance with the evidence adduced, and it is difficult to see how any other verdict could have been reached. The history of the whole affair, in brief, is that of a boat built at Elswick-on-Tyne on the yard account, and doubtless with the expectation of later effecting a sale to the Admiralty. When completed and offered she was found weak by the inspector, and was considerably strengthened in her decks and other features. She was then bought, placed in commission, and in due course of time ordered from the Tyne to Portsmouth. En route she fell in with bad weather, and, due to the stresses developed among the waves, seems finally to have collapsed and foundered, with nearly all on board.

In this brief career and tragic ending we may find abundant food for thought regarding the suitability of the general type of torpedo boat and torpedo boat destroyer for service at sea. It is true that we have had no indications in our own boats of any such weakness, and it is not likely than any such condition exists. This case does, however, furnish evidence of how small a margin we are likely to have in such designs, and how little change there might be needed to carry any given design across the danger line. The demonstration is perhaps one which was needed to be made, though the loss of life is to be deplored. If the lesson shall be heeded, however, the sacrifice may not have been in vain.

THE CONTEST FOR THE PRIZES.

All articles intended for competition for the two prizes of $15 and $10 each, mentioned in our advertising pages, must be sent in promptly, as the contest will close on December 31.

All articles published will be paid for at the regular rates. The best and the next best will draw the prizes in addition.

Repairing Piston of Dynamo Engine.

On the morning of the 17th of November, 1901, the dynamo engine on the steamship *Curacao* started making an unusual noise. Stopping and taking off its cylinder head, the piston nut was found slack and the

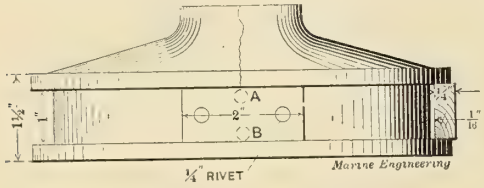


FIG. 1.

piston cracked across its diameter and down one side, as shown at *A*, Fig. 1, and on the opposite side down to *B*. Repairs were made, as shown by the accom-

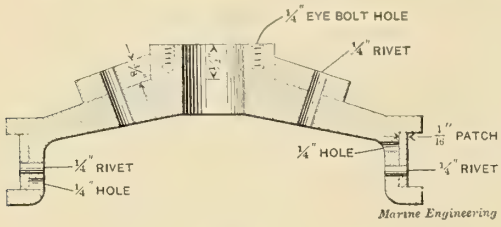


FIG. 2.

panying sketches. One quarter inch holes were drilled at the ends of the crack and patches were fitted. The top patch is a washer such as carpenters use, 4 inches

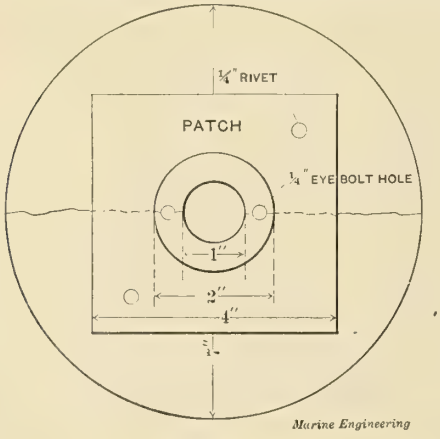


FIG. 3.

square by 3-8 inches thick, of sheet steel and with a hole in it 1 1-2 inch diameter. This washer was heated and dished, the cylinder head being used for a former. The piston boss fillet was also filed, as shown in Fig. 2, and that part left about 1-64 inch larger in diameter than the parallel part of boss, and the patch hole filed to just go over the parallel part. Patches were then put in the packing ring groove, the groove being deep enough to allow 1-16 inch thickness of metal. Rivet holes in these patches were spaced to draw. The top patch was then heated, hung on the parallel part of the boss and squeezed over the filed part in the vise, using a 2-inch pipe coupling against the patch to seat it. In cooling, the crack where it already extended to the lower flange, Fig 1, *B*, went through. The piston was then tried on the rod and with nut set up the crack did not open a particle. Being put in place, the engine was started and has now been running 10 nights without showing the least sign of weakness. The ship is home and a new piston can be had. A patch could not be put on the bottom of the piston because the crank pin bolts were not long enough to allow its being raised, while, of course, the cylinder head could be easily raised with a thick gasket. L.

How a Broken Shaft Was Repaired.

A few years ago I was awakened out of my sleep on the steamship ——, on a rough and windy night, by the first assistant engineer pleasantly informing me that the intermediate section of shaft was broken.

On going into the engine room I found a frightful mess. The water was swashing from one side to the other, and pouring in through a large leak in the circulating discharge pipe through the condenser, close to the hull of the ship. The first thing to be done was to get the water out of the ship and stop the leak. All of the pumps on board which could be connected to the bilge were operated by a link from the intermediate crosshead excepting one small Worthington, 8 by 6 by 6 inches. This latter pump we started up, but soon the ashes, which had washed into the bilge from the fireroom, plugged it up. I shut off the Kingston valve and took out the length of pipe next to the seacock, and thus the suction of the circulating pump opened into the bilge. I then disconnected or broke the shaft coupling just aft the thrust bearing, and started up the main engine to pump out the bilge by the bilge and circulating pumps. The bilge water passed through the condenser, and 75 per cent of it leaked back into the hold through the break in the discharge pipe. There was no check valve on the ship's side. I stopped the engine, took out the broken length of pipe and slipped one end of a canvas ventilator or wind sail around the remaining length and carried the other end up and out of a porthole, which was eight feet above. The canvas was bound in place, the discharge hole in the ship's side plugged up with mats, and the main engine was slowly started again. We did not take long to get the level of water down in the bilge by using both the bilge and the circulating pumps, the latter discharging its water through the condenser and the canvas ventilator overboard through the porthole. I then put the section of inlet pipe next the Kingston valve back in place, and the bilge pump took care of what little leakage there was.

I then went again to examine the shaft, and, because we practically had no tools on board, it appeared doubtful whether the repairs could be made. The company that owns this ship was so mean that they let the captain buy the engineer's supplies. The outfit of tools was made up of only a few wrenches and hammers which were fit for old junk. This was my first trip on this ship; I had joined her on the morning she sailed, and after examining the engine room and outfit I decided that the next port would be my jumping off place, wherever it might be.

However, it was necessary for us to make some kind of a job, as we were entirely helpless and 900 miles from port. The break in the shaft was two-thirds the length of the shaft from the forward coupling. As the boilers were fitted with forced draft, I got some old retarders out of the tubes, straightened them and lashed them lengthwise on the shaft over the rupture. I then cut down some of the wire rigging and wound it round the shaft, starting from the after end and winding it over to the left forward, as the engines were right-handed. I took out a coupling bolt at both the forward and after couplings and put in a ring bolt taken from the deck, and to these I made the wire fast, serving it back and forth, winding in the same direction, so that when the engines should start the tension would bind the wire down hard over the break. Then I made fast a chain to a key placed through the after ring and carried it to the forward ring. Next we bolted up the coupling which we had previously disconnected, and were now ready to go ahead. Steam was turned on very slowly, until it looked as if the wire would not stand the strain. The engines were again stopped, and we spent three hours serving that shaft with chain, which was the hardest part of the job; but when it was done it looked like a bunch of eel grass on the shaft. Upon starting up very cautiously I found to my delight that the shaft next the engine rotated only one-third of a revolution before it brought up solid on the chain, and the propeller end rotated all right. We gradually turned up the engine to 40 revolutions and made about four knots. When we got in sight of land I turned her up to 50, as I was getting reckless, and informed the captain not to go in port with the expectation of the engines reversing, as the chain was so wound that to reverse the engine would be to unwind it, and if he signaled to stop not to be too sure about starting them again. So we were going along nicely, when I ordered the assistant to turn her up to 60 or 65, for, now that we were in the harbor with plenty of tugs around, I wanted to find out how much the gear would stand. But as soon as he started the throttle the chain carried away, but the wire held on for 200 revolutions and then parted. The performance of the wire at this stage surprised me, and no doubt it would alone have brought us in at 40 revolutions, or at least I think so.

The total time taken for making repairs was from Friday morning, 1.30, until 9.30 that night, and our jury rig had carried us 892 miles. Most of the time of the repairs was taken up in repairing the pumps and condenser. The break in the discharge pipe was due to the racing of the engines when the shaft broke.

"CHIEF."

Repair of Broken Bearing Frame and of Small Piston Rod.

While in a heavy blow one day No. 6 frame of the steamship *Corona's* engine started going up and down and in a few moments the journal started to heat.

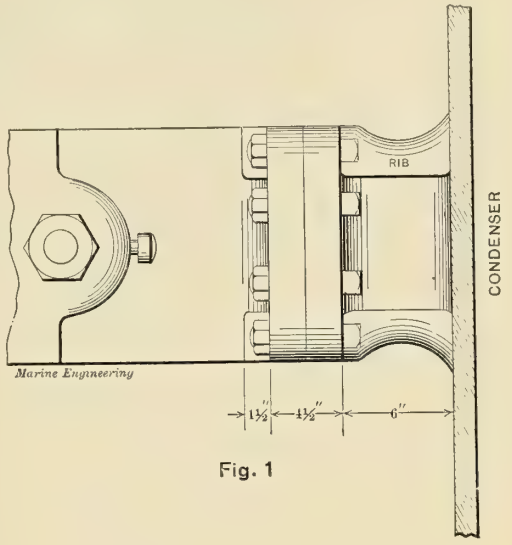


Fig. 1

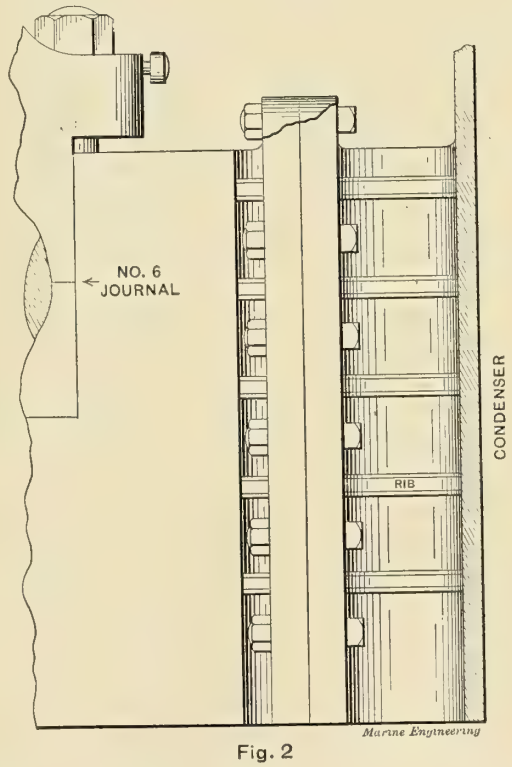


Fig. 2

PLAN AND ELEVATION SHOWING REPAIRS TO ENGINE FRAME.

Stopping the engine, the top of the flange, as shown by the serrated line in Fig. 2, had broken off through the bolt holes. The holding down bolts were then gone over and all the tie bolts in No. 6 frame were set up

hard and the engines were again started at a slower speed, and everything went along all right till the next port—about 100 miles. On investigation it was found that the two top holes had been fitted with turned bolts, all the rest with 7-8-inch rough bolts, and of course the two top holes were out of business. The frame had worked up and down as much as a 7-8-inch bolt in a 15-16-inch hole would let it. No tools being at hand, a reamer, as shown in Fig. 3, was made by one of the engineers, on a lathe kindly lent by the engineer of an electric light station. This reamer worked so well that a wrench could be kept on the

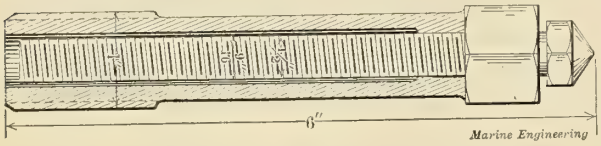


Fig. 3

feed screw continuously. Two holes in the side of No. 6 were then reamed and fitted with turned bolts. Afterwards, as opportunity offered, three holes in each side of each frame were fitted the same way.

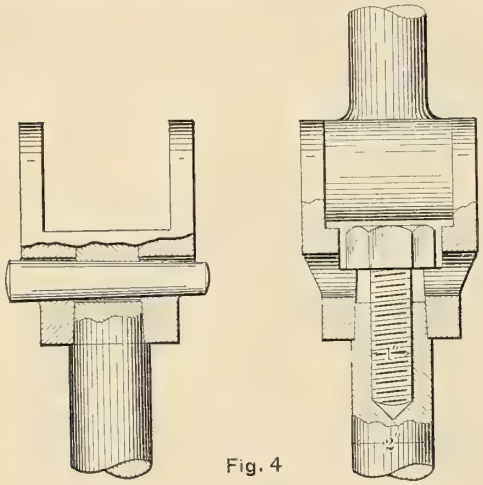


Fig. 4

On the same ship, some time later, the piston rod in the reversing engine parted in the keyway in getting to a wharf. Although the rod had parted, the reversing engine, of course, could still be used one way. The other way the links were pulled over with a chain tackle, thus making the wharf. The job was repaired, as shown by the right hand sketch, Fig. 4, and required about four hours. The rod and crosshead were drilled and counterbored in place, the counterbore being made with just a flat projection for guide while the rod was being drilled and tapped for the stud. Arriving at home a new rod was made and fastened with a nut in the crosshead. Originally, although the key was in double shear, its area was larger than that of the rod surrounding the keyway.

H. L.

Experiences With Injection Valves.

Thinking that the following experiences I have had with injection valves might be of interest for your "mishap" columns, I take the liberty of forwarding you descriptions of the same.

While I was connected with one of the smaller shipyards on the Delaware River, a tugboat came to the yard for a general overhauling. After she had come off the marine railways it was noticed that the joint under the cover on the 8-inch main injection valve was leaking badly. The valve had been ground in and overhauled while the tug was out of the water, but through some carelessness the old gasket had been put back in place, although it was nearly worn out and unfit for further use. I first had the joint set up on as tight as possible, thinking that would stop the leaking, but this did little or no good. I could have driven white pine wedges around the joint and stopped the leak temporarily, but that would look badly on a valve that had just been overhauled. To haul the vessel out on the railways again would have been too expensive, so I determined to try and put in a new gasket while the tug was in the water.

The cover was secured to the body of the valve by eight 3-4 inch studs and nuts, and luckily the studs had not been cut off flush with the tops of the nuts. I accordingly slacked back on all of the nuts about three threads each. I then screwed down hard on the handwheel until the joint was broken and the cover had brought up on the nuts again. I continued this operation until each nut was only held by about two threads on its stud, which gave me a 3-4 inch opening between the cover and the flange on the valve.

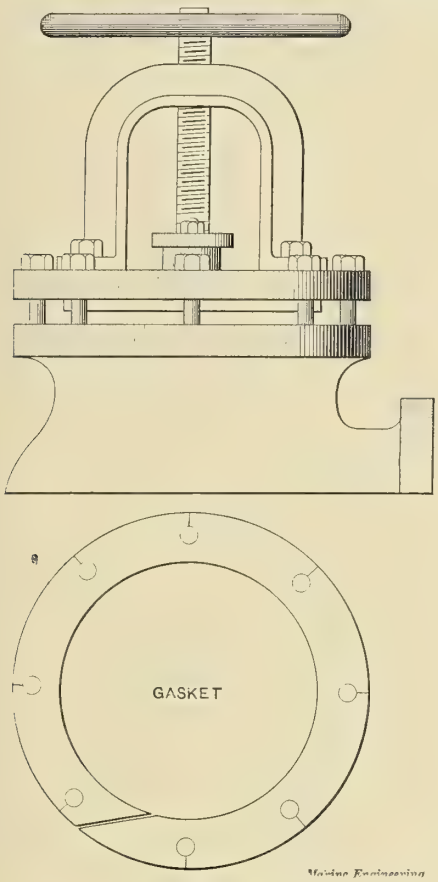
To cut out the old gasket with a case knife was but the work of a few moments. A new gasket was then cut to fit the flange, but instead of being continuous, I cut it diagonally, and opposite each bolt hole I made other cuts extending to the outer circumference of the gasket. Then after rubbing some black lead and tallow on the gasket I succeeded after a half hour's patient labor in getting the new gasket in place by working it around under the cover flange and between the studs. After it was in place the hand wheel was gradually turned back and the nuts set up on, until the cover was down firmly in place. The valve was then opened to the sea, and the joint was found to be perfectly tight.

The sketches on the following page will illustrate the method adopted:

The other instance, while not exactly a "mishap," is certainly one of interest.

It occurred on one of the Philadelphia city ice boats, which are maintained for the purpose of keeping the channel open in the Delaware River during the winter months. It was found that the 16-inch main injection valve would not furnish sufficient water for the condenser owing to its becoming partially stopped up by the jumbled ice which would be drawn up against the strainer. It was therefore decided to fit an additional injection valve. The ice was so thick in the river as to prevent the vessel being hauled out on any of the marine railways, or dry docks in the vicinity, and as her services were badly needed, the almost unheard of task of fitting an injection valve and strainer to the hull while the vessel was in the water was undertaken. To accomplish this a mat about ten feet square was first made from six thicknesses of heavy canvas, quilted

together. The edges were roped and at each corner heavy cringles were fitted, to which guy ropes were fastened. The mat was then worked down under the ship until it covered that part of the vessel's bottom where it was proposed to fit the new valve. The strake of plating to which the valve was to be attached was about 1-2 inch thick. Holes for the strainer were laid off on the inside of the plating and drilled with a ratchet, thus using the bottom of the ship for the strainer. The drill would go through the plating, but by a little care it would not cut the canvas, which was held up tightly against the bottom by the pressure of the water. It was, to be sure, a long and tedious job to drill these hundreds of holes, but it was even-



REPLACING A GASKET IN INJECTION VALVE.

tually accomplished. The pattern for the valve seating was then fitted to the hull of the vessel very carefully, and after it was cast it was chipped to as neat a fit as possible. Holes were drilled through the cast iron flange in the machine shop, and the corresponding holes were drilled through these into the skin of the ship. The holes in the plating were then tapped and studs screwed into them, after which it was a comparatively easy job to fasten the seating in place and bolt the valve to it. After all connections had been made, the canvas mat on the outside was removed and the joints were found to be tight. In fact the job was so substantially done that it has been in use for seven or eight years without any additional repairs made to it.

JOHN QUINCY.

Camden, N. J.

THE PROFESSOR ON SHIPBOARD.

Story of an Attempt to Combine Theory With Practice.

BY C. A. MCALLISTER, FIRST ASSISTANT ENGINEER, R.C.S.

CHAPTER V.

The following morning the Professor went on deck early and found that the storm had entirely subsided, although there was still a considerable roll on. The sky was clear, without a sign of a cloud in sight, and there was every indication that the day would be very hot. The sailors were busy about the decks, sweeping and setting the awnings. He first went in to breakfast, and after eating heartily, felt so much refreshed that he decided to devote nearly all day to the engine room.

After a few moments' pleasant conversation with his brother, the Chief Engineer, he put on his overalls and went below. After greeting the engineer on watch, he went down to the lower engine room and met his new-found friend, Barney, the oiler, who was hustling around at his work, humming an old Irish ballad and vigorously smoking his pipe. "Good morning, Professor," said he as he caught sight of the visitor. "I'm going to see what I can do towards using less cylinder ile this morning." "That's right, Barney," replied the Professor. He then went up and spoke to the engineer of the watch and got his permission to reduce the supply of oil in the cylinders. The automatic lubricator on the main steam pipe was then slowed down so that only about two drops a minute passed through. The oiler going off watch at 8 o'clock, had put some oil in the cylinders through the cups screwed into the cylinder covers, as the custom was to give a little oil to each cylinder every hour in this manner. When 9 o'clock came Barney appeared a little fidgety, and said that he was afraid if he did not put some oil in the cylinders she would "grunt," as he expressed it. "We will try it, anyhow," said the Professor.

Noticing the oiler come up on the grating with a two-gallon feeder in his hand, and commence filling up the reservoirs for the automatic lubricating systems, he turned to the engineer and said that nowadays the best practice was to have a 25 or 30 gallon reservoir fitted as high up in the engine room as possible. By means of a pump in the lower engine room connected to the main oil tanks, this overhead tank could be filled without carrying oil around the engine room. To fill the reservoirs on the sides of the cylinders, all that was necessary was to open a cock or small valve and let it run in by gravity. Noticing that these small reservoirs were of the old-fashioned cast brass kind, he stated that the best type he had seen were cylindrical in shape, and that the ends were of glass, so that the height of the oil in them could be seen at a glance. This brought up the subject of automatic lubrication, and the Professor informed the engineer that he believed a great deal of oil was wasted by such methods as those in general use. The regulation of the feeds, he said, appeared to him to be of great importance. If left entirely to the oiler, he would be liable to give the various pins and bearings too much oil in order to be on the safe side, and also to save himself the trouble of getting around and feeling the bearings too often. He said that he was of the opinion that for ordinary running the best plan would be to

give only the crossheads and crank pin brasses steady lubrication, and let all other journals be oiled by hand at regular intervals. The assistant engineer said that he was not very much in favor of automatic oiling either, as he had on several occasions experienced difficulty in having the oil pipes plug up or in having the feed valves clog.

The Professor suggested that these difficulties would probably be overcome if the inside surfaces of the pipes were tinned, in order to prevent the formation of verdigris, caused by the acids in the oil, making a chemical combination with the bare brass of the pipes; and also stated that the oil should be properly strained before it was put in the reservoirs to avoid the "clogging up" of the feed valves. Noticing that they were using lard oil, he asked why they did not use a mineral oil. To this query, the assistant replied that he did not know any good reason for not using it, only that they always had used lard oil since he had been on the ship. The Professor then stated that he had made laboratory experiments with certain grades of mineral oils and found that their lubricating qualities were better than lard oil. In addition to that he said that mineral oils would not smell so badly in the bilges as lard oil, and that he understood that the mineral oil was cheaper. From conversation with many sea-going engineers he said that he had formed the impression that it was only prejudice which prevented them from using mineral oils, instead of the old-fashioned practice of using lard oil for everything. Barney, who had been listening to this discourse, chimed in just then by saying, "Yes; and that hog grease is moighty bad stuff when it gets thrown in your eyes or gets into a cut on your hand."

It now lacked only a few minutes of 10 o'clock, and as yet no "grunts" had been heard from the cylinders or valve chests. However, the Professor suggested that a little cylinder oil be put in the three cylinders. "That's right," said Barney; "she's loike an old toper, it won't do to shut off her allowance too short."

The Professor continued his discourse on lubrication, and said that he had been informed that many engineers used grease compounds wherever possible, some even using it on the main bearings. He said that he considered this as rather bad practice, and that on bearings or journals having comparatively little motion grease could be used with advantage. For instance, he said, grease cups on those journals on the drag links would be all right, and more economical than using oil. He also said that grease cups would be all right on reverse shaft bearings. Coming to the subject of oiling main bearings, he said that he considered it a mistake made by many to put oil in the middle of the bearing only, contending that as the ship always had more or less drag, the tendency of the oil was to run aft and thus leave the forward parts of the bearings unlubricated. Oil boxes on main bearings, he contended, should always be fitted with two wick feeds, one on the forward end of the cap or binder, and the other on the after part.

On the subject of eccentric straps, he said his idea would be to oil them by hand, through a small cup secured to the side of the eccentric rod, and having a pipe leading to the center of the bearing surface on top of the strap. With slide valves the eccentrics had to do considerable work, and unless they are designed with large bearing surfaces they are very liable to warm up. He suggested that to save using such a large amount of oil on eccentrics, as is customarily used to keep them cool, they could be arranged to dip into fresh water held in galvanized iron or sheet brass drip pans secured beneath each pair of eccentrics. Barney said, "Yes, and it's a foine lot of lather you would have by churning up that mineral oil and fresh water in an ould drip pan." "There's where you are mistaken, my man," replied the Professor. "While it is true that the ordinary mineral engine oil will make a lather when mixed with fresh water, there is a non-saponifying grade of oil that will not produce that trouble. Before Barney had a chance to ask questions, the Professor explained that "non-saponifying" meant literally that it would not make soap. "Shure," said Barney, "I wish it would make some soap, as it's little enough we get aboard here to wash our clothes in."

As it was time to oil the piston rods and valve stems, the old oiler got out a tin can, which he had half filled with cylinder oil, and proceeded in a dextrous manner to coat the surfaces of the rods with oil by using a swab improvised from a stick and a bunch of waste. While he succeeded in getting the most of the oil on the rods, there was a considerable portion of it that dripped down on the connecting rods and valve gear. This, the college man thought, was a rather bad practice, so he explained to the oiler that on many modern ships he understood that each valve stem and rod had a separate oil pump secured to the cylinder casing in a convenient position, with a small pipe connecting directly to an oil space just inside of the supplementary gland, in the stuffing-box. By a few strokes of the pump sufficient oil would be forced in to thoroughly lubricate the rod. He went on to explain that for the high pressure valve stem and piston rod there was sometimes a pressure of steam in the oil groove in the stuffing-boxes, and that it was usually the practice to fit a small check valve in each of the pipes connecting the pumps to the stuffing-boxes. "That ought to be a fine scheme," said Barney, "as it won't dhribble any ile over the engine."

"Barney, what becomes of all the oil that drips off the engines?" asked the Professor. "Well," said the oiler, "I suppose the poor fish must get it, as it all goes in the bilges and is pumped overboard." "There, again, the ship is behind the times," said the Professor. "The modern practice is to have the crank pits made water tight, and each fitted with a strainer and drain pipe. All these drain pipes lead into a large pipe, and that empties into a galvanized iron tank fitted in between the frames aft of the bed-plate, and lower down than the bottom of the crank pits. The waste oil is then drained into the tank, from which it can be baled or pumped out about once a watch. This waste oil on some ships is put through a filter and can be used again. That is another contrivance that is coming into use; in fact, every large ship should be furnished with a good oil filter, as it will soon pay for itself in the amount of oil saved by it, which would otherwise be pumped overboard and wasted." Barney

replied that the oil tank scheme wouldn't work, as the discharges from the water service would fill the tank up in very short order. "That is no drawback," said the Professor, "as the water service discharges should lead directly into the bilges and not go into the crank pits at all."

The Professor's attention was next attracted, as it had been on the previous day, to the fact that ordinary tallow was being used in the thrust bearing. Barney was stuffing some rancid tallow in between the rings, and at the same time elevating the end of his nose. "Professor," said he, "can't you get up some way of iling this thrust instead of this stinking tallow?" "Why, yes, Barney; there is a much better method in use on new vessels. Nowadays thrust bearings are so designed that the lower part forms a water-tight box. This is filled with oil, and the collars are about half submerged in it. As they revolve sufficient oil is carried up to thoroughly lubricate the horseshoe bearings. Of course the oil gets warm from the great amount of friction, but it is quite easily kept cool by circulating sea water through a pipe coil in the bottom of the oil chamber. It is the custom with this style of thrust to fit an oil-tight cover, made of sheet iron or brass, over the top of the bearing to keep the oil from being thrown out in the shaft alley." This idea seemed to meet with Barney's approval, and he remarked that he would like to get on a ship with some of the labor-saving devices which the Professor had described to him.

The college man was by this time pretty nearly worn out by the intense heat, and as it was near the noon hour he went to his room, washed up, and ate his dinner. He lingered around on deck for a time, enjoying the welcome shade of the awnings. The ship was now in the tropics, the heat was becoming very oppressive, and the Professor shuddered when he thought of again going into the engine room. However, as he had made up his mind to spend all day there, he reluctantly put on his perspiration-soaked overalls and again went below. The heat was even greater than it had been in the morning watch, so he walked over until he got under one of the ventilators. There he was joined by the first assistant, who had the watch. The Professor told him what success he had met in regard to using less cylinder oil, so the engineer called up his oiler and told him to put oil in the cylinders only twice during the watch.

Looking over at the engine room thermometer, the Professor saw that it registered 128 degrees. The officer on watch assured him that that was nothing unusual, and that he expected it would get even higher than that. This somewhat startled the book man, and he wondered if he could stand it any hotter than it was. The hot air made the membrane in his nostrils smart, and he concluded that, although there were some pleasant experiences in a marine engineer's life, this standing a four hours' watch in the tropics was not to be numbered in that category.

Going down below he found the atmosphere in the lower engine room somewhat cooler, but hot enough at the best. "Why don't you take off your jumper?" said the oiler. This the Professor proceeded to do, and as he stood there, arrayed in undershirt and overalls, he did not present a very dignified appearance, but he found it much more comfortable.

After making a thorough examination of the water service, as that seemed to be the only cool apparatus in the engine room, he rejoined the first assistant under the ventilator. He asked him if they had much occasion to resort to the use of water on the journals, and was told that it was very rarely used, except the regular circulation through the guides and main bearings. The Professor said that he noticed that the pipes over the crank pins were bent in many places. This, the first assistant replied, was caused by the men standing on the pipes when overhauling the engine. The Professor suggested that it would be a good idea to make them of extra heavy pipe and secure them firmly to the main pipe at the back and to the columns in front. "I notice," he continued, "that the main supply pipe running along the side of the condenser is of ordinary brass pipe. In my opinion, it should be of cast brass, eccentric in section and not less than ½ inch thick at the heaviest part. This would give a firm support to the branch pipes, without brazing or bosses, as you have them here." He went on to tell the assistant of a scheme which an ingenious friend of his had arranged on a Government vessel whereby all the discharge pipes from the main bearings were led to one central location and secured to a bracket, the ends of the pipes being spaced about an inch apart. The engineer or oiler could then tell by running his hand through the several streams if any of them appeared to be warmer than the others. In this way his friend claimed that he could at once ascertain whether any of the bearings were becoming the least bit heated, and just which they were. The same arrangement could be applied to the discharge pipes from the guides.

In order to observe the working of the air pump, the Professor walked around back of the engine and stood there in meditation for awhile. He suddenly felt rather faint and everything began to look black before his eyes. He made a rush to get out of the engine room, and as he half stumbled out of the door the ship's doctor happened to see him in time to prevent him from falling on the deck. Summoning one of the waiters, he shouted: "Run quickly and get me some ice; the Professor has been overcome by the heat."

Mounting Blueprints.—A correspondent of the *American Machinist* gives his method of mounting blueprints for use in the shops as follows: The advantages of this method are that first, prints that have become out of date owing to changes in the drawing, can be easily cut from the boards and new ones put in their places; second, one of them was never known to warp, all lying as flat as the traditional pancake, and third, it is a much simpler process, as I mount them dry and do not have to put them in a press.

I make the prints an inch or two larger each way than the boards I am to mount them on, and clip the corners down to the size of the boards. Then I fold the margins around to the back side of the boards and fasten the edges down with paste, preferably Higgin's Photo-Mounter. This way also gives protection to the edges of the cardboard and it never frays out at the corners.

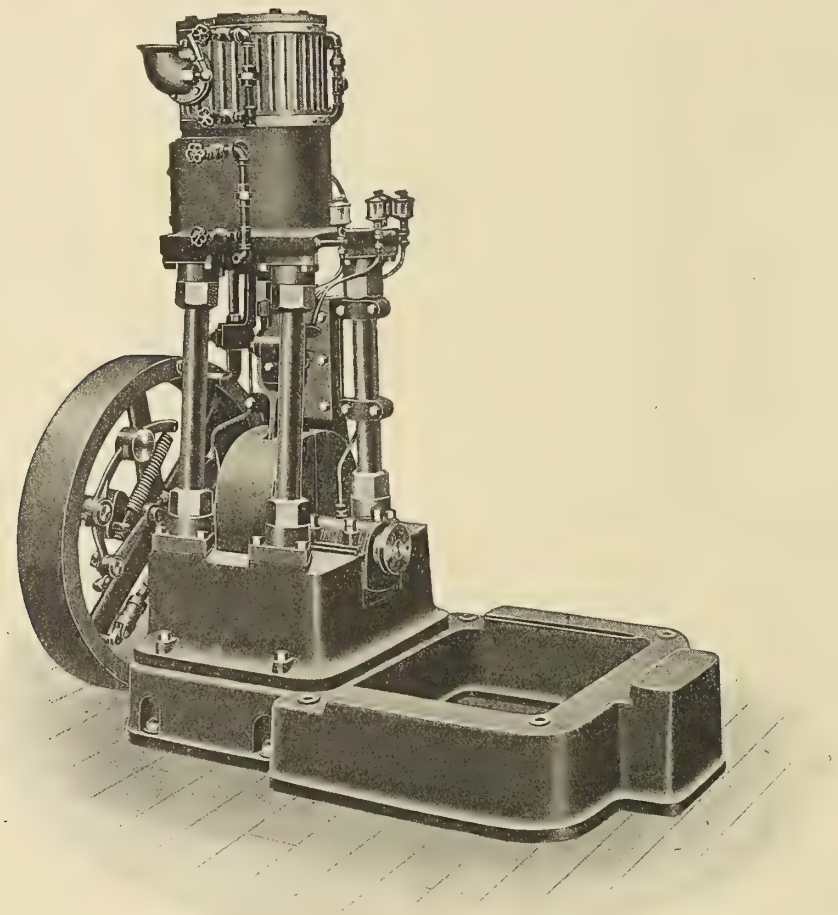
DIRECT CONNECTED ENGINES FOR SETS.

Marine Steeple Compound Engine.

The accompanying cut illustrates a type of marine engine manufactured by the Buffalo Forge Company, of Buffalo, N. Y., and recently applied to service on the great lakes. It is built on steeple compound lines, with the high-pressure cylinder superimposed upon the low-pressure cylinder. The high-pressure cylinder is cast in one piece with its lower head and valve chest. The latter, being circular to accommodate a valve of the piston type, is bored out to receive two cast iron bushings or cages, which are drawn simultaneously in place, one from either end, and in turn bored to form seats for the valve. The high-pressure valve itself is constructed of two hollow pistons, so carried on the valve spindle as to admit of independent adjustment. Each piston of the valve has a single snap ring, which forms its entire bearing face, and which is clamped between two side plates by means of three bolts. After the valve has been constructed, it is carefully turned down to a working fit in the valve chamber. If at any future time it is desired to compensate for wear, the locking bolts on the valve pistons are loosened to allow the snap rings to expand, after which they are again tightened. A very ample space is allowed for lagging the high-pressure cylinder, which finally receives a polished, corrugated covering.

The low-pressure cylinder is fitted with a D slide valve carried on the same spindle with the valve above. Large port openings are provided and a removable plate gives access to the valve for adjustment. The low-pressure cylinder has the lower head cast as a part thereof, together with extensions for the attachment of the frame.

The frame is composed of rods of cold rolled steel, four in number, two perpendicular ones at the rear and two in front, slightly inclined. The maximum stress coming upon any one of these rods, of course, but slightly exceeds in value one-fourth of the maximum piston rod stress, and hence it will be apparent that in this style of frame construction a very high factor of safety is combined with maximum accessibility of the moving parts. This solidity affords also freedom from vibration, which feature is further enhanced by the mode employed for securing the rods to the head and base. On both ends of the several rods a large jam nut firmly holds a triangular pad, which is itself bolted to the base or the low pressure head flange, as the case may be. On the two rear posts is bolted the guide plate, and though the direc-



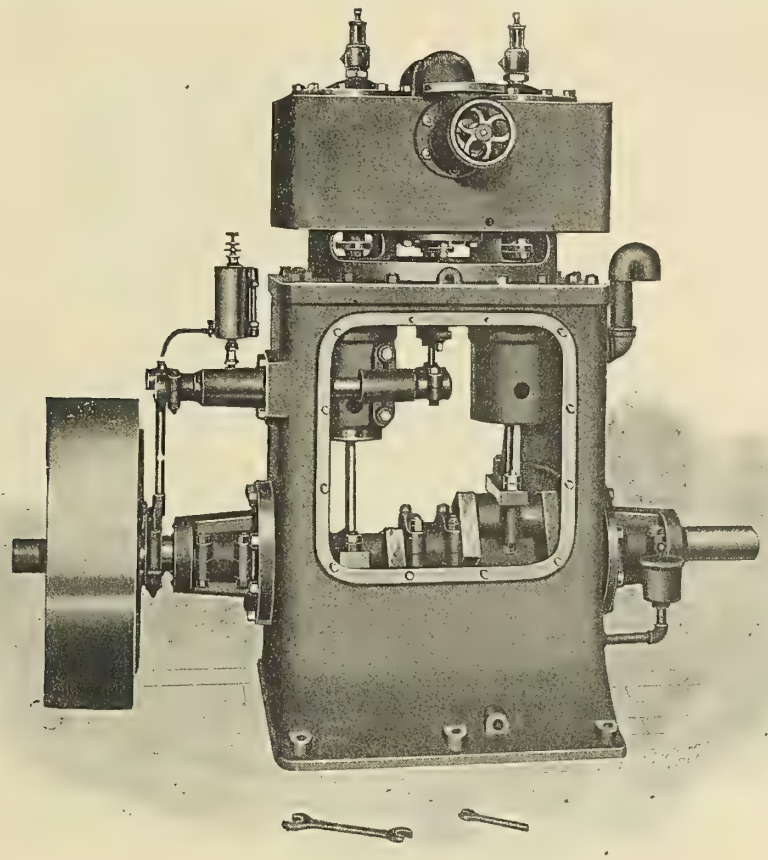
STEEPLE COMPOUND ENGINE.

tion of rotation is such that the guide pressure is always taken up by this plate, the crosshead shoe is fitted with auxiliary enclosing guides bolted to the main guide plate. The connecting rod at its upper part has a forked end, while the other end is of the locomotive strap and wedge type. The crank shaft is of forged steel, large in diameter, with long bearings in the base and is provided with counter weighted crank discs.

The base is carried on a sub-base which gives the fly-wheel the proper floor clearance, and which, in this instance, is arranged for directly connecting to the engine an Elwell Parker Electric Company generator. Close regulation is afforded by a governor of the centrifugal fly-wheel type, and by reason of its three means of adjustment, together with the provision of oil or grease cups on all the governor pins and on the various bearing surfaces of the valve motion as well, great sensitiveness may be secured. Abundant lubrication is characteristic of the engine and is assured by a series of sight feed oil cups feeding the rubbing surfaces through brass tubing. The arrangement is such as to cause the oil after use to drain into the crank pit, whence it may be drawn and filtered as desired. In the engraving is shown the device for trapping the oil escaping from the outer ends of the main journals. The lubricant from the end of the bearing is guided by a plate into a narrow receptacle on the outside of the bed, from which connection is made with the crank pit. In order to prevent the projection of any particles of oil from the rotating parts, a light polished hood is furnished, as shown. The material used in the building of this engine is the very best, and in point of nicety of construction and finish, it is in perfect keeping with the best marine engine practice.

A Cornish Cycle Engine.

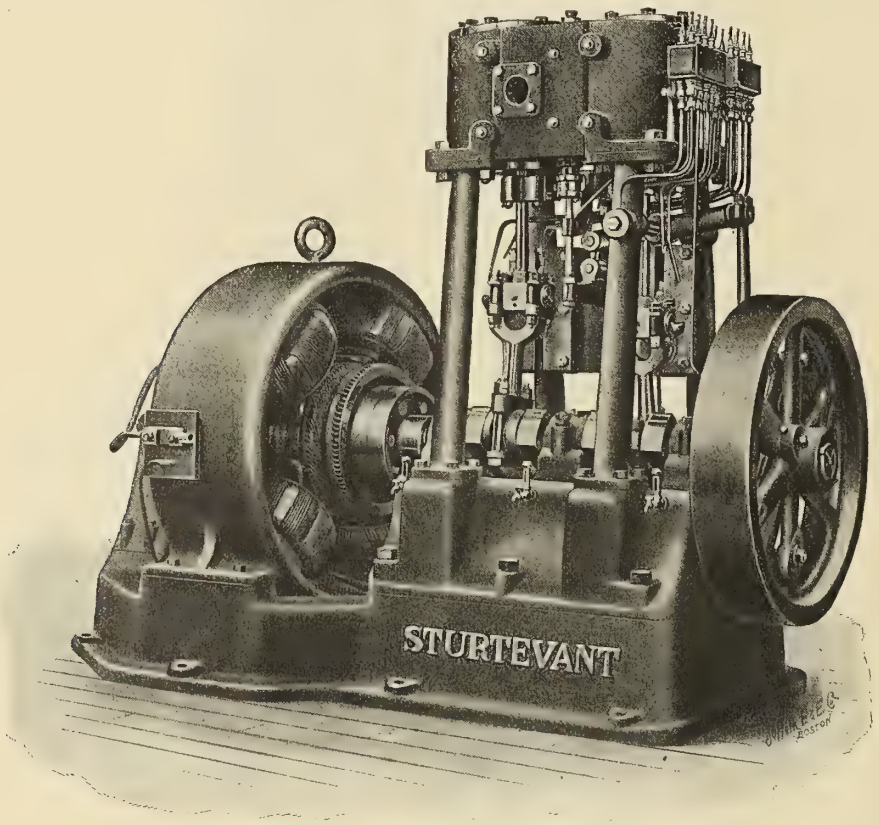
The design of the automatic Cornish cycle engine, built by the Fuller Company, Detroit, Mich., is such as to produce an engine that will run noiselessly at the highest speed of revolution. The natural difficulties of the ordinary double acting engines for high speed has led to the introduction of the single acting type for that service, and, while this type eliminates some difficulties, it has its own inherent disadvantages.



AUTOMATIC CORNISH CYCLE ENGINE.

The engine here illustrated embraces many of the advantages of both types. This engine is set vertical, and has the usual cylinder, piston, rod, crosshead, guides, connecting rod and double cranks of the double-acting type, but the operation of the steam on the piston is entirely different, the so-called "Cornish cycle" being adopted, and it is the only engine of the type made in America for high speed. The high-pressure steam is admitted to the top of cylinder only. After having done its work there it is transferred below the piston by the valve establishing equilibrium between both ends of the cylinder, and closing at the proper point on the up-

stroke of the piston to prevent any tendency of the connections leaving the crank pin. On the down stroke the steam is exhausted to the atmosphere, or to a condenser, where the vacuum forming under the piston removes the back pressure. Thus the piston is, at all times, whether working condensing or non-condensing, exerting a downward pressure on the crank pin, which enables the engine to run noiselessly at high speed. The stuffing-box of the piston rod is in the open space between cylinder and crank case, and being on the low pressure side of the cylinder can be quite slack and free from friction. The engine is of an enclosed type, with splash lubrication, which offers many advantages when



COMPOUND ENGINE DIRECT CONNECTED TO GENERATOR.

run at high speed. The Rites single weight governor is fitted and will regulate within 2 per cent. The engine is built of the best material and workmanship, with single or double cylinders, compounded if desired, and is adapted to any service where a noiseless, high-speed engine is required.

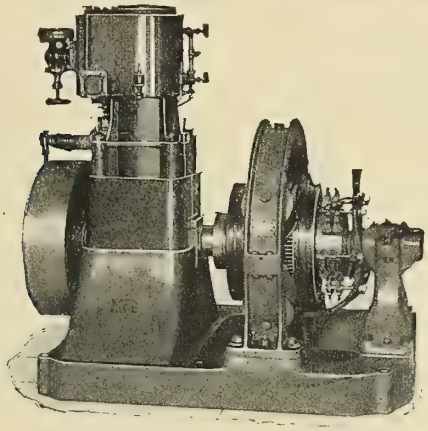
Compound Engine Generating Set.

In the accompanying illustration is presented a design of one of the direct connected generating sets built by the B. F. Sturtevant Company, of Boston, Mass. This company started with the building of motors for direct connection to fans, but is now turning out an engine in over one hundred sizes and under 250 horse-power, for running fans and dynamos. The engine is of the vertical compound open type, and the generator is a 4-pole type. In this design the bed carries three main journal bearings, brass bushed in their lower halves and provided with continuous oiling devices in connection with oil reservoirs beneath. Its interior is formed into a basin, which collects all drip from water or oil. The four heavy upright columns are securely fastened to this bed, and to the upper ends is bolted the single cylinder casting, comprising the two cylinders, which are of relatively large diameter and short stroke. Two piston valves are operated in unison by a single rocker and yoke, each regulating the admission of steam to one cylinder. The crossheads are of the slipper type with projecting crosshead pins, the connecting rods have yoked crosshead pins and are of large size. Both connecting rods and crossheads are of forged steel, and all parts of the engine are of the highest grade as regards material and workmanship. The cylinders are thoroughly lagged. Complete sight feed oiling arrangements are provided for all bearings. These engines are built in sizes 6 1-2, 11 by 5 1-2 and 7, 13 by 5 1-2, with output at 150 lbs. of 47.5 and 60 H. P. The armature shaft is direct connected to the engine shaft and carries an armature of the barrel wound toothed drum type, with slotted discs of carefully annealed sheet steel, which, after being coated with an improved insulating varnish, are mounted upon a cast iron drum. This drum is provided with longitudinal air ducts, which connect in turn with radial ducts passing through the core, and by means of small blades

or vanes inserted in these ducts, compel the circulation of a constant current of air, thereby greatly facilitating ventilation and insuring an extremely cool running armature. The winding for all low voltage machines is of copper bars. High voltage or very slow speed machines have the armature wire wound with machine-formed coils, which coils are thoroughly insulated before being placed upon the core. The magnet frame is of special magnet steel and has the field cores cast therewith. The ring is cast in one piece. The commutator consists of drop forged segments of pure copper, mounted upon and secured between cast iron flanges of spider construction which allow a circulation of air inside as well as outside, thus conducing to low temperature. Carbon brushes only are used in these machines and mounted in holders of the sliding socket type, with easy facilities for adjustment and removal. A full load run for a sufficient length of time to bring every part to its maximum temperature has never been found to produce a temperature rise exceeding 40 degrees centigrade.

Direct Coupled Power and Lighting Plants.

The appearance of the small, direct coupled generators of the General Electric Company is shown in the accompanying illustration. The present design of



SIMPLE ENGINE DIRECT CONNECTED.

these machines is the result of numerous experiments and a practical experience of many years. For small installations, where a separate engine is necessary to drive the generators, these sets will be found to be nearly as cheap as belted machines. They are compact and simple in arrangement, and for small isolated stations, where space is limited or belting objectionable, they are much desired. The engines require a minimum amount of attention, and, for machines of this size, are very efficient. The generators are of the multipolar type and are compound wound. They regulate automatically within 2 per cent over the entire range from no load to full load, no change being required in the field regulating rheostat and the brushes remaining at the neutral point. The engines are of two types, vertical single cylinder and vertical tandem compound. Where high pressure steam is available and economy of operation an essential consideration, the tandem compound engines give the best efficiency. The compound engines have been adopted by the United States Government for the vessels of the navy. Special attention has been given to the system of lubrication of these sets, and all parts are oiled automatically under pressure, thus reducing the labor to a minimum and ensuring perfect lubrication. The vertical single cylinder engines are as economical as any engine of this type on the market. Both types possess the same desirable features, namely, simplicity, compactness, stability and durability.

Windlass and Capstan for the Siberia.

The accompanying illustrations show a plan and side elevation of the steam and hand windlass, with warping capstans, furnished for the steamships *Siberia* and *Korea*, building at the works of the Newport News Shipbuilding and Dry Dock Company for the Pacific Mail Steamship Company. The windlass is designed for handling 3-inch stud link chain cables at a speed of about five fathoms per minute. The windlass proper is mounted on three bitts, carrying two wildcats with locking gear and a worm gear. A double inverted vertical engine, mounted on a bedplate, common to both windlass and engine, drives the windlass by a worm which runs in an oil-tight casing beneath the worm gear mentioned above. Provision is also made for working the windlass by hand by means of pump brakes. The wildcats, which are loose on the shaft, are fitted with a positive locking device, so they can be easily connected or disconnected from the windlass. Friction band brakes of large diameter are fitted to each wildcat, the bands being operated by compressor wheels, as shown, and having ample surface to "ride by" with the windlass unlocked. On the ends of the windlass shaft are securely keyed gypsy ends, with barrel 27 inches in diameter, for handling heavy hawsers.

The engine cylinders are 16 inches diameter by 14 inches stroke, designed for a working steam pressure of 200 pounds per square inch.

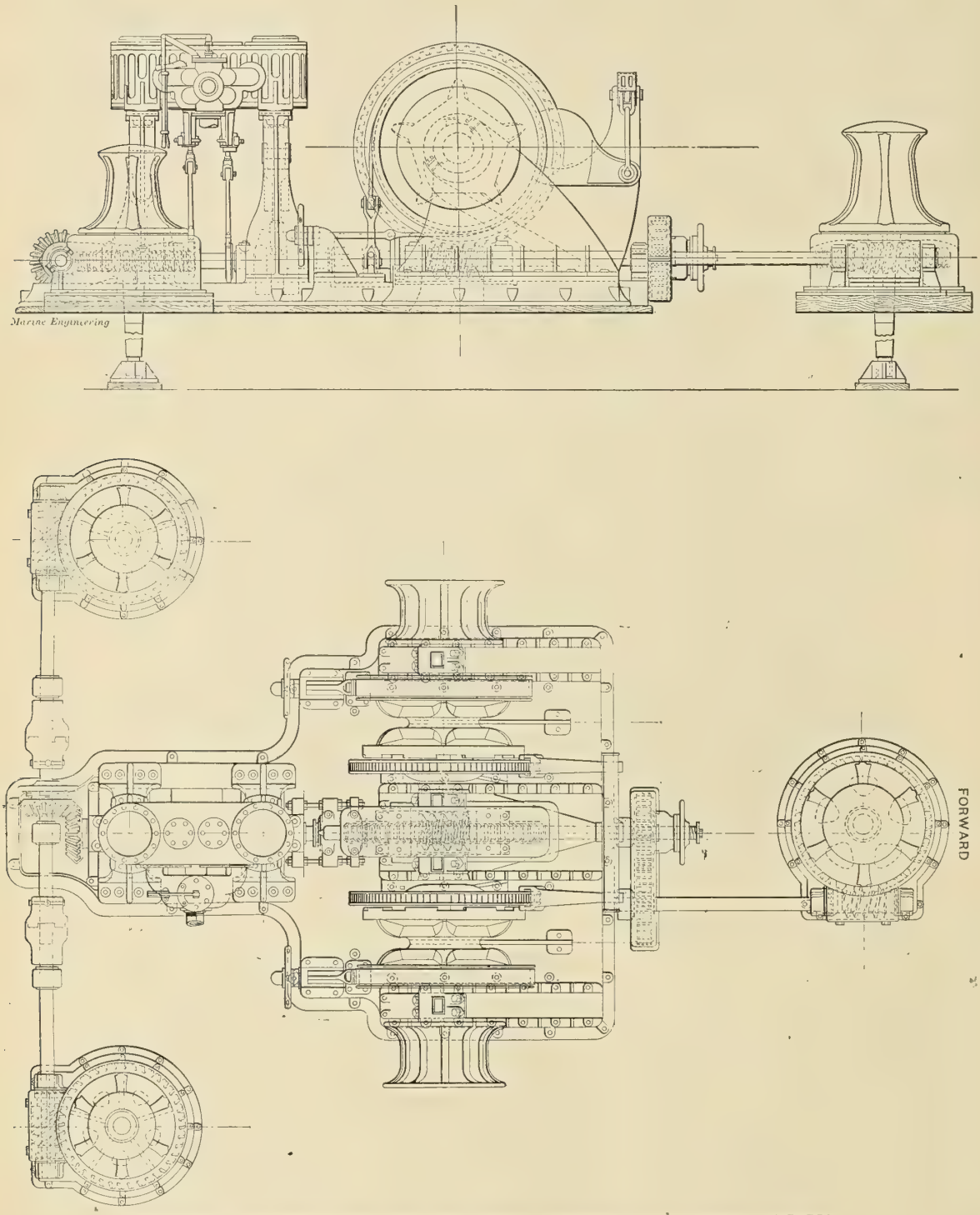
The worm and crank shaft are coupled together by a flange coupling. The thrust of the worm is taken on an independent thrust bearing adjustable for wear in either direction, and so arranged that the collars on the worm shaft will be solid with the shaft and run on white metal thrust surfaces.

The three warping capstans shown in the illustration are operated by the windlass engine, and can be run at the same time as the windlass, or any one of them may be disconnected and run independently. The capstan located forward of the windlass has a barrel of 20 inches diameter. This capstan is turned by means of single-thread worm gearing with a ratio of 40 to 1. The counter-shaft, which carries the worm and clutches, is connected to the continuation of the worm shaft by spur gears of such size as to bring the capstan on the center line of the ship. The two speed capstans located aft of the windlass, one on either side, are driven from the engine crank shaft by bevel gears and four-threaded worm gearing, which has a ratio of 10 to 1. Clutches for disconnecting either capstan are furnished as shown.

The total weight of windlass and capstans is 50

tons, which fact emphasizes the great power and strength necessary to warp these large steamships and handle their heavy chains and anchors.

New Ships.—The Townsend and Downey Shipbuilding and Repair Company, of New York, have contracted to build in their shipyard at Shooters Island,



WINDLASS AND CAPSTAN FOR THE NEW PACIFIC STEAMSHIP CO.'S STEAMER SIBERIA.

These machines were designed and constructed by the Hyde Windlass Company, of Bath, Me., who are also furnishing the cargo winches, warping capstans for the stern, and Brown's patent steam tiller and hydraulic telemotor for these ships.

Borough of Richmond, two steel freight ships of the following dimensions: Length, 360 feet; breadth, 50 feet; depth, 29 feet; cargo capacity, 6,000 tons. They will be built for the Standard Oil Company, to be used in carrying oil in bulk.

SPARKING PRODUCED BY DEFECTIVE COMMUTATORS, AND THE REMEDY.

BY WM. BAXTER, JR.

In order that commutator brushes may run without sparking, the first requirement is, that the machine be properly proportioned. The next requirement is that the commutator be true and the brushes firmly but elastically held, so that they may not separate from the surface of the commutator at any time.

If the commutator is set so as to be eccentric with the shaft, it may run well, providing the diameter is large and the velocity low, but with small diameters and high speed, the brushes will be thrown off every revolution, when the low side comes around, and at these instants a spark will be produced. If the machine is allowed to run in this condition the sparking will continuously increase, because as the sparks will pass when the low side is running under the brush this side will be made still lower by the disintegrating action of the sparks.

If a commutator is set so as to run true with the shaft, but has one or more flat spots, then every time these pass under the brushes there will be sparking, and as in the case of an eccentric commutator, the longer the machine runs the worse the sparking will become. From this it will be seen that if the commutator surface does not run true sparking cannot be prevented. Therefore the only cure in such cases is to true up the surface. The use of sand paper for this purpose is of very little service. It will produce a noticeable difference in the sparking for a short time, simply because with a smooth surface the brushes are less liable to bounce when passing from the low to the high parts, but an effectual cure cannot be made without turning or grinding the commutator surface so that it will run true. In the case of a generator, this trueing can be done by running the machine with the brushes removed, and then rigging up a temporary rest to hold the turning tool. To do such a job a man must know how to use a hand turning tool, for as every one who is an expert in turning knows, a novice cannot hold the tool so that it will not follow the depressions in the work, and nine out of ten will not even be aware of the fact that the tool is simply scraping off the surface without removing the high spots. Turning and grinding attachments for trueing up commutators are made in several designs, and are provided with means for attaching them to the frame of the generator. For all except those skilled in the art of hand turning, these attachments are indispensable.

The commutator of a motor is not so easily trued up, because the machine is not so set up that it can be driven by some external power. In most cases the easiest way to do the work is to place the armature in a lathe. When this is done care must be taken to ascertain whether the bearings on the shaft run true when the latter is run on the centers. In many cases it will be found that the bearings run eccentric, and if such is the case, the best course to pursue is to place the motor, if possible, in a position where it can be driven, and then turn the commutator off while the armature is running in its own bearings. If this cannot be done, then place the armature in the lathe and support the commutator end in a steady rest set at the center of the bearing. In this way the commutator surface will be turned off so as to run true with the bearings at its end of the shaft; and if it is not perfectly true with the other bearing the effect will be to cause it to wobble slightly, but not enough to affect the action of the brushes; that is, in machines of ordinary size and run at ordinary speeds.

In some cases commutators appear to run perfectly true, and yet, when in operation, for some unaccountable reason, they suddenly begin to spark badly. Such cases are generally caused by loose segments, which at times retain their true position, and then from a sudden jar or increase in speed are thrown out of position, and are thus either above or below the surface of the commutator.

In small commutators loose segments always rise above the surface, but in large commutators they may rise above or drop below. Why there is this difference in the two cases can be made clear by means of Figs. 1 and 2. The first one of these illustrations shows a small portion of the surface of a commutator of small

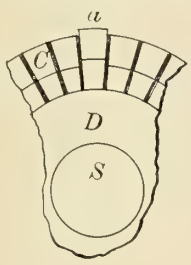


FIG. 1.

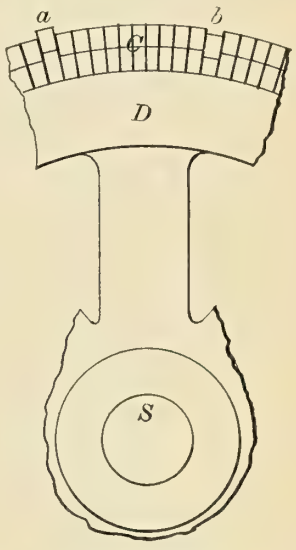


FIG. 2.

diameter. As will be seen the segments are much wider at the face than at the bottom; therefore, if one becomes loose, it will be able to rise above the surface, as shown at *a*, but it will not be able to drop down, for the slightest depression will tighten it up. In Fig. 2, which shows a portion of the surface of a commutator of large diameter, it will be noticed that the difference between the width of the segments at the surface and at the bottom, is not very much; therefore, a loose segment could drop below the surface a considerable distance without becoming wedged. Thus it will be seen that with large commutators a loose segment can drop below the surface, as shown at *b*, just about as easily as it can rise above, as at *a*. From these facts it is evident that if a segment becomes loose in a small commutator it can be tightened and restored to its true position by simply inserting additional insulating material between it and its neighbors, and then tightening up the end clamping ring.

In the case of large commutators, if the loose segment drops below the surface, it will be necessary to place additional insulation under it, as well as on the

sides, for no matter how tightly it may be held sideways, it will be liable to be depressed unless it rests upon a solid foundation.

The material used for commutator insulation is mica, and sometimes asbestos is mixed with it, either in the insulation under the segments, or in that at the ends. A small thickness of asbestos at either one of these places is advantageous because on account of its compressibility it will give until the insulation at other points is forced down to a solid bearing by the pressure of the end clamping ring. It can be easily seen that if the insulation between the segments is made of mica, which is practically incompressible, the diameter of the outer surface of the commutator cannot be reduced below a certain point, for to reduce it it would be necessary to compress either the segments or the mica. If likewise the layer of insulation under the segments is made of pure mica, and therefore incompressible, the segments cannot be drawn down below a certain diameter, and if this diameter is not small enough to take up all the slack between them, some will remain loose. If the insulation in the under layer is built up in part of mica and in part of asbestos, then it will be slightly compressible, and on that account it will be possible to squeeze it up until the segments come together tightly. Under these conditions all the slack may not be taken out of the under layer of insulation, but it will be compressed sufficiently to hold the segments firmly, so that they cannot be depressed.

The ends of the commutator segments, against which the clamping rings bear, are turned off truly in the majority of machines, but in clamping up the commutator, the segments are liable to be forced slightly out of true. Therefore, if the insulation at the ends is an incompressible mica ring, it will not give to the irregularity in the form of the ends of the segments, and will not hold all of them with an equal degree of firmness. If, however, this insulation is made in part of asbestos, so as to yield slightly, then if in clamping up the segments, their ends are forced a trifle out of true, the give in the insulation will compensate for this irregularity, and all the segments will be securely held.

If every part of a commutator is made strictly accurate, it can be put together with solid mica insulation at all points and be perfectly firm, but from the foregoing explanations it can be easily seen that the degree of accuracy required is beyond practical attainment. Even when the bottom and end insulations are made compressible, by the admixture of asbestos, it is necessary to proportion all the parts with the greatest of accuracy to obtain a firm job. In many cases where pure mica insulation is used, a considerable amount of insulating varnish is placed between the layers of mica, of which the sheets and rings are made, and when the structure is tightened up it is heated, thus softening the varnish so that it may be forced out at the points where not required. This process makes a tight commutator in a new machine, but in the course of time the constant heating of the commutator will allow the varnish to work out from other parts, and thus loosen some of the segments.

When a loose segment is to be tightened up the end clamping ring will have to be removed. In some very large generators, this ring is made in a number of sections, each one being held in position by two or more screws. In a machine of this design, the section of the clamping ring that covers the loose segment can be removed, and then the additional insulating material required to make the segment tight can be inserted, and the clamp replaced. In this operation there will be no danger of the segments that are uncovered becoming so loose or displaced that they cannot be forced back into position when the clamp is restored, because the varnish used with the insulating material holds the segments together so that they form a solid mass. If the whole clamping ring has to be removed, then the segments will have to be supported, for if not they may drop out of place so that they cannot be brought back into their true position when the clamp is replaced. A very easy way to hold the segments is illustrated in Fig. 3. The cord *e* should be small and hard twisted, having as little stretching quality as possible. It should be wound tightly around the commutator, making as many turns as the surface will hold. When fully wound, hard wood wedges are forced in as shown at *a a*, one on each side of the defective segment. The best plan

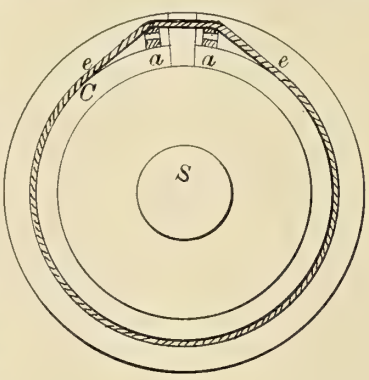


FIG. 3.

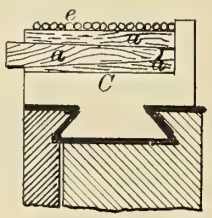


FIG. 4.

is to use three wedges, as shown in Fig. 4, the top and bottom ones being placed under the cord when it is being wound. These two wedges should be very thin and the center one should be thick. The advantage of this arrangement is that in driving the middle wedge, the cord is not forced out of place, as it is very liable to be if a single wedge is used.

When the segments are securely clamped by means of the cord bands, as in Fig. 3, the clamping head can be removed, and the loose segment can be tightened up. In putting in additional insulation to tighten a loose segment it is necessary to place the material where it is required. Thus if the segment is simply loose, so that it rocks from side to side, then additional side inulation will be required; but if it drops below the surface, insulation will have to be placed under it as well as on the sides. If the segment rises above the surface, then insulation will have to be added at the ends where the end clamping rings press.

Sometimes when an armature becomes short circuited, the defect is found to exist in the commutator, and is due to defective insulation caused by oil impregnated with metallic dust, which from time to time finds its way to the end of the commutator. In cases of this kind, the existence of such short circuits can be judged

from the general appearance of the commutator. If it has an oil-soaked appearance, it is reasonable to infer that some of the segments are short circuited through impairment of the insulation. Defects of this kind will be noticed principally in motors, for in generators, armature short circuits result in burn outs before time is given to discover their existence.

Whenever it becomes necessary to remove the end clamp from a commutator, to look for defects of any kind, the rope clamp of Fig. 3 can be used; but, as in such cases it is desirable to turn the armature around freely, while inspecting it, it is advisable to use two

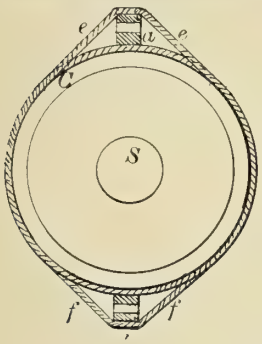


FIG. 5.

FIG. 6.

clamps, as is shown in Fig. 5, and if the commutator is of very large diameter even four may be used, as in Fig. 6. If two clamps are used, each one must cover one-half the commutator surface, the center being taken up by one clamp, and the front and back by the other, this latter being made in two bands. With three clamping bands, each one will occupy one-third the surface, and with four, each one will be of a width equal to one-fourth of the surface. A very good way to make these bands is to use narrow belting, winding it one, two or three layers deep, according to the size of the commutator. For small machines, however, strong cord is the most easily managed, and is entirely satisfactory.

Boston Technology Excursion.—Under the direction of Professor Peabody, the fourth year class in naval architecture at the Massachusetts Institute of Technology recently left Boston on the steamship *Howard* to visit the leading shipyards on the Atlantic coast. On the run to Norfolk a speed and power trial were conducted by the students. The latter part of the excursion was devoted to visiting the yards at Newport News, Sparrows Point, Washington Navy Yard, New York Shipbuilding Company and the William Cramp Ship and Engine Building Company.

The shipbuilding industry in the United States, exclusive of the United States Navy Yard, according to a preliminary report of the Census Bureau, just issued, had a total invested capital of $76,699,651 in 1900. This is an increase of 181 per cent since 1890. The value of products, including custom work and repairing, was $73,444,753, an increase of almost 93 per cent. There were 1,083 establishments and 46,121 wage-earners, with total wages of $24,388,109; miscellaneous expenses, $3,582,257, and cost of materials used was $33,031,280.

TECHNICAL PUBLICATIONS.

The Royal Navy List Diary and Naval Handbook for 1902, paper covered, 120 pp., 6 by 9 1-4 inches, price 75 cents net, foreign postage, 16 cents, Witherby and Company, 326 High Holborn, London, England.

This book contains much historical and statistical information respecting the Royal Navy, its administration, strength, stations and cost, statistical abstracts of all matters concerning service, astronomical notes and tables, tables of tides and tidal constants, and a calendar of notable naval events. There is also a complete obituary of the year, with details of the war and meritorious services of deceased officers of the Royal Navy, the Royal Marines and the Royal Naval Reserves, and an exhaustive summary of the year's naval progress. Then follows a large diary, with index and blanks for reports on gun practice, and other items of interest to naval officers.

How to Build a Three-horse Power Launch Engine. By E. W. Roberts. Size 10 x 12½ inches, pp. 66. Gas Engine Publishing Co., Cincinnati.

This book is specially intended for the increasing class of amateurs who may wish to build such machinery for their own use. The writer is the author of *The Gas Engine Handbook*, and has had much experience with machinery of this character. The immediate purpose of the author is to furnish a design for a complete launch engine for a small boat, together with all the necessary instructions for its construction in the shop. The text is accompanied with fourteen full-page plates reduced from a set of working drawings, and showing in detail and with full dimensions all parts of the machinery. The text is clearly written, and contains many useful hints regarding the construction of the machinery, as well as a considerable amount of useful discussion relating to such machinery in general rather than this design in particular. With the aid of this book any good mechanic, or any amateur with the aid of a mechanic, should be able to provide himself at moderate cost with a small motor of standard type and excellent general design. This book may be cordially recommended to those who are interested in such machinery, and especially in the details of its design and construction.

SELECTED MARINE PATENTS.

686,780. PROPELLING AND STEERING OF BOATS. MATHEW J. STEFFENS, CHICAGO, ILL.

686,883. LIFE-SAVING APPLIANCE. CHARLES BASWITZ, BERLIN, GERMANY.

CLAIM.—As a means for imparting buoyancy to life-preservers and other articles, a mass of kapok fiber enclosed in a flexible sack of suitable material.

687,077. DIVING DRESS. FREDERICK H. SPRANG, LONDON ENGLAND.

CLAIM.—A diving dress made of a inner fabric, coated with vulcanized rubber on its outer surface, and an outer fabric cemented thereto, the pieces of the outer fabric being larger than the corresponding pieces of the inner fabric and alone being stitched together, each seam with the adjacent inturned margins of the outer fabric being proofed by a cover strip of vulcanized rubber-coated fabric cemented both to the inner fabric and to the intervening portions of the outer fabric.

687,241. MOTOR FOR PROPELLING BOATS. JOHN F. KERNS, BUFFALO, N. Y.

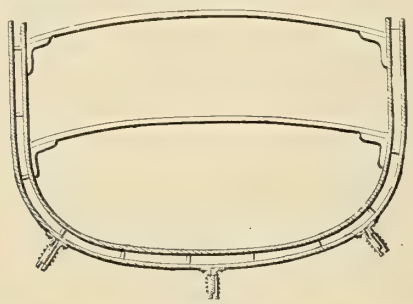
CLAIM.—A means for propelling boats, comprising walking-beams, a propeller, two independent mechanisms connected to

the propeller, means for operatively connecting either of said mechanisms to the walking-beams, and means for rocking the walking-beams.

687,325. SCREW PROPELLER. JAMES B. MACDUFF, BROOKLYN, N. Y.

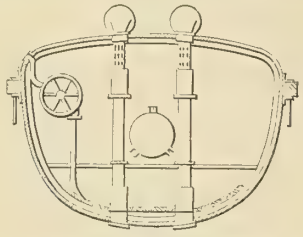
CLAIM.—The combination with a hull or body of a vessel provided with runners and a keel, of braced bearings mounted upon the deck platform of the vessel, a shaft journaled in said bearings, an air propeller having a hub rigidly connected with said shaft, and provided with a surrounding hood or shield adapted to confine the air within the radius of the blades, and to serve also as a fly-wheel; a transverse drive shaft, gearing between said drive shaft and the propeller shaft, and means for operating the drive shaft, substantially as described.

687,398. ARMOR PLATE. DAVID W. GARRIGUES, WOODBURY, N. J. ASSIGNOR OF ONE-HALF TO ELBERT A. CORBIN, PHILADELPHIA, PA.



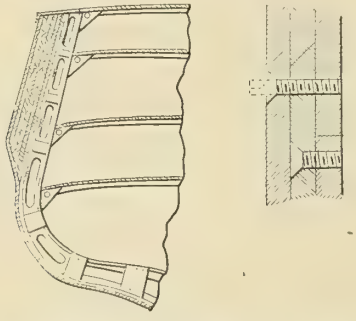
CLAIM.—Armor for a battleship, consisting of a series of superimposed layers, each composed of a series of plates arranged substantially in the same plane and parallel to each other, and in which the fiber or grain in the plates of each layer is arranged at a different angle than the fiber or grain of the adjacent layer or layers, and, further, in which the plates of the outer layer extend downward and over the lower edges of the remaining plates and united to the bottom of the vessel so as to form a continuous sheathing over the portions of the armor of less vertical depth.

687,638. VENTILATING APPARATUS FOR LIFE-BOATS. JAMES MAIN, LIVERPOOL, ENGLAND.



CLAIM.—In a life-boat, the combination of a ventilating-tube open and perforated at each end with a sleeve or band slidably mounted thereon at each end to automatically cover and uncover said perforations to exclude the entrance of water and permit the free entrance of air in all positions the boat may assume, substantially as described.

687,910. CONSTRUCTION OF VESSELS. JOHN S. WATTERS, NEW ORLEANS, LA.



CLAIM.—The combination with a hull of a vessel, of the keel secured thereto, apertures transversely disposed in said keel, and resilient tongues secured at their forward end to said keel and projecting rearwardly into said apertures.

The combination with the hull of a vessel, of a plurality of keels provided with transverse apertures, and resilient tongues secured at one end in front of said apertures and projecting rearwardly into said apertures and having the rear end free, substantially as described.

The combination with the hull of a vessel, of a keel made of two parallel plates secured thereto and provided with transverse apertures, of a plurality of resilient tongues bolted between said plates and having their rear ends free and projecting into said apertures, substantially as described.

The combination with the hull of a vessel of one or more webs, fins or keels running longitudinally and secured to the outer and resilient tongues, each secured at its forward end to said web, fin portion of said hull, with apertures in said web, fin or keel, or keel, and projecting rearwardly into said apertures with its rear end free, substantially as described.

688,135. AIR-SHIP. JOHN SPIES, PHILADELPHIA, PA.

688,398. MEANS FOR ALTERING THE TRIM OF MARINE CRAFT. WILLIAM A. DODGE, FALL RIVER, MASS.

CLAIM.—Means for altering the trim of a marine craft, consisting of two stand pipes near opposite portions of the hull, a tube connecting said stand pipes and provided with zigzag or spiral portions, a mass of heavy liquid in said pipes and tubes, and means for forcing said liquid from one stand pipe to the other.

Means for altering the trim of a marine craft, consisting of stand pipes at opposite points of the hull, a tube connecting said pipes, a mass of heavy liquid in said pipes and tubes, loose pistons in said pipes resting on said liquid, and means for forcing the liquid from one pipe to the other.

688,584. AIR-SHIP. ROBERT H. BOOTS, ALBUQUERQUE, NEW MEXICO.

688,607. VESSEL SOUNDING-ROD. WILLIAM H. DIXON, CHICAGO, ILL.

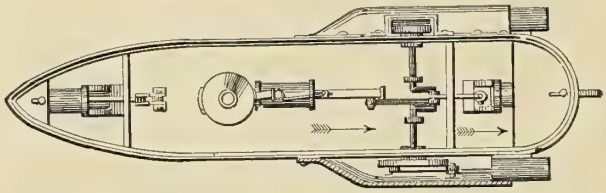
CLAIM.—In a device for the purpose set forth, the combination with the tube having a float arranged therein, an indicating and measuring rod attached to the float, the cap-plate and guide-tube arranged at the upper end of the tube, and the cap adapted to cover the end of the guide-tube, substantially as shown and described.

In a device for the purpose set forth, the combination with a tube having a screen or strainer at the bottom thereof, of a float arranged within the tube and having rollers arranged thereon adjacent to the upper and lower ends of the float, the upwardly projecting rod having a scale or indicating marks thereon, the cap-plate arranged upon the top of the tube, the guide-tube attached to the cap-plate, and having anti-friction rollers at its lower end, and the cap attached to the cap-plate to cover the central opening and the upper end of guide-tube.

688,643. SELF-FEATHERING PADDLE-WHEEL. DAVID W. HORTON, PETERSBURG, IND.

CLAIM.—A feathering paddle-wheel comprising a central shaft having rigid collars, a series of radial arms secured to the collars at their inner ends, said arms being made widest at or near the middle, and converging therefrom outwardly and also inwardly, circular stay-rings bolted to the radial arms at their widest parts, and a series of paddle-blades hinged to the stay-rings between the radical arms and adapted to be supported against the inclined face of either of the extensions of the arms, substantially as and for the purpose described.

688,692. MEANS FOR PROPELLING SHIPS. RICHARD RICHARDS, MIDWAY, KAN.



CLAIM.—The combination with a vessel provided with cylinders on its opposite sides open at their rear ends, of pistons arranged to reciprocate in said cylinders, an engine carried by the vessel, operative mechanism located at the sides of the vessel and connecting the engines with the pistons and shields secured to the sides of the vessel and tapering rearwardly and covering and protecting the operative mechanism connections at the sides of the vessel.

Marine Engineering

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RISDON IRON WORKS, SAN FRANCISCO.

GENERAL DESCRIPTION OF THE NEW SHIPBUILDING PLANT.

The main shops and the shipbuilding plant of the Risdon Iron Works are located on the water front of the Potrero, between Nineteenth and Twenty-second streets, San Francisco, California. The property consists of thirty-five acres, lying between Georgia street and the shore line, which is here nominally Massachusetts street, and includes the former site of the Pacific Rolling Mills.

SHIPYARD PUNCH SHOP, RISDON IRON WORKS.

The main entrance is at Twentieth and Louisiana streets, four blocks east of Kentucky street, on which is the nearest electric car line. The main line of the Southern Pacific railway's bay shore extension is three blocks from the entrance on Illinois street. From this a spur runs down Twentieth street through the main gateway, which is forty feet wide, and there spreads out fan shaped into four branches. All these tracks are interconnected by curves of 150 feet radius, allowing a choice of two or three routes from almost any point to any other, thus preventing the annoyance and delay of blocking traffic. For instance, there are four possible routes from the machine shop to the shear legs—the ultimate destination of all large marine work. The total length of trackage about the works is four miles.

The general arrangement of the buildings is as follows: North of Twentieth street is located the shipbuilding department proper. It consists of the mold loft and ship tool building, plate racks and shipbuilding ways. South of Twentieth street the first tier of buildings is as follows, going toward the bay: New office, blacksmith shop, angle-bar shed, warehouse, joiner and ship-pattern shop and fireproofing and riggers shops. The next tier south consists of machine shop, storeroom, power house, copper shop and boiler house. The following tier contains the erecting shop, extension to the machine shop, pattern shop, boiler shop, foundry, flask shop and flask yard. There is a complete line of wharves on the bay frontage, including a fitting-out slip, surrounded on three sides with wharfage and railroad tracks. It will be noticed that the grounds are amply provided with railway facilities —in fact, a track has been laid wherever it could be of use. As all the curves are 150 feet radius, the usual

(Copyright, 1901, by Marine Engineering, Inc., New York).

flatcars and railway yard locomotives have access to all parts of the works. The complete track system also makes it possible to utilize all the space not occupied by buildings for storage. Material and all heavy articles are carried about the works by three yard or locomotive cranes, having a capacity of ten tons. These are also used for switching cars.

The buildings are constructed of structural steel, covered with galvanized corrugated iron, thus being fireproof throughout. The foundations are concrete piers. Under the machine shop, boiler shop, foundry and blacksmith shop, piers are laid upon bedrock, as the site of these buildings has been excavated from the surrounding hills. The ship tool building columns and each separate machine rest upon concrete piers nine feet deep, which, in turn, are built upon piles from seventy to ninety feet long, driven to bedrock. The joiner shop is similarly supported, though the distance to bedrock is not so great.

The lighting facilities are ample. Each shop is completely equipped with arc and incandescent lamps, so that work can be carried on continuously night and day when necessary.

POWER.

Four kinds of power are distributed completely throughout the works—compressed air, hydraulic, steam and electric.

Compressed air is used for hoists, drills, riveters, caulkers and other pneumatic tools, the provision for the ship building and repairing plant, wharves and fitting out slip being especially complete.

Hydraulic power is used for large riveters, punches, jacks, drop forging presses, hoists, keel plate bender, etc., and also for testing.

Steam is used outside the power-house itself for steam hammers and heating purposes.

The main source of power, however, is electric. Nearly all machines, except the special hydraulic and pneumatic and the steam hammers, which require over five horse power, are independently driven by electric motors. The smaller machines are belt driven from line shafts, each having its own motor.

POWER HOUSE.

This is a thoroughly modern, one-story steel structure, 100 by 150 feet, situated in the center of the plant. It is the producing and distributing point for the different power systems mentioned above, and also serves for the salt and fresh water distribution for drinking and fire purposes, as well as petroleum distribution for the boilers, blacksmith shop and boiler shop fires.

The boilers (now being installed) are of the Heine water-tube type, and will eventually supply all the power used in the works. They are oil burning, as are also those upon the locomotive cranes.

The electrical equipment includes: Two 250 K. W. static transformers, 11,000 to 440 volts; two 150 K. W. static transformers, 11,000 to 196 volts; one 50 K. W.

VIEW OF THE RISDON IRON WORKS FROM THE WATER.

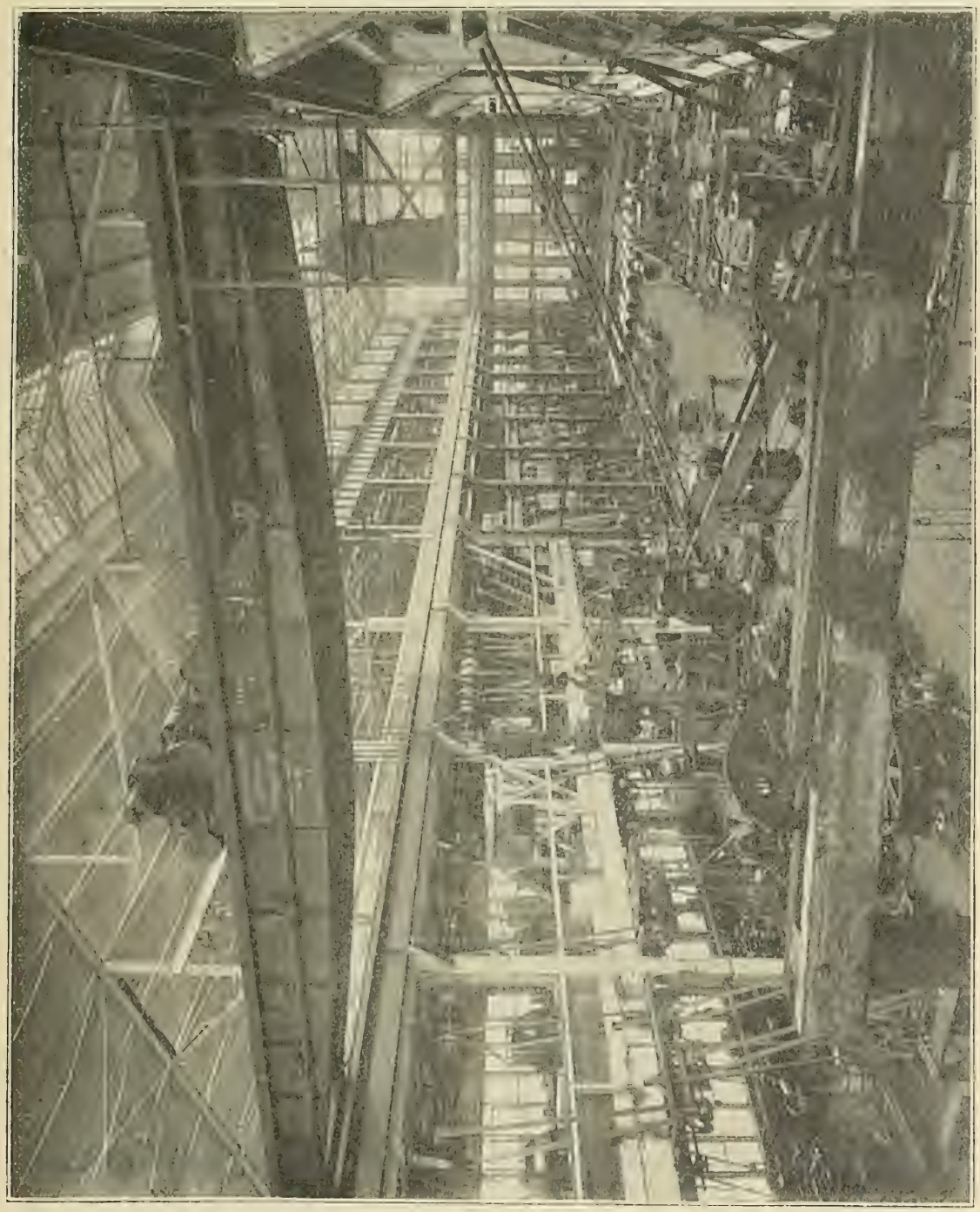
static transformer, 2,200 to 110 volts; two 25 K. W. static transformers, 2,200 to 110 volts; two 10 K. W. static transformers, 440 to 110 volts; one 250 K. W. rotary converter, 196 to 220 volts. All are supplied with the necessary switches, ammeters, volt meters, watt meters and other requirements. At present power is taken from the mains of the Independent Light and Power Company, at 11,000 volts, two-phase, 60 cycles. Provision, however, has been made to install generators which will furnish all the power required.

The direct current system is used to operate all the overhead traveling cranes and two or three small motors. The alternating current system supplies power to the remaining motors and the arc and incandescent lamps.

The hydraulic power system is supplied by a 150 horse power, triple throw, double acting pump, driven by an induction motor. This pump produces a pressure of 1,500 pounds per square inch, and feeds a battery of four accumulators, which automatically control the output. The power is then distributed through a system of manifolds to the various departments.

The compressed air is furnished by a 300 horse power, two stage, intercooled compressor, directly connected to a compound Corliss engine. Provision is made for adding more when required. The compressor delivers through a receiver to the mains at a pressure of 100 pounds per square inch.

sure on the mains. As the salt water is also used for condensing and sprinkling the grounds the pump is constantly in operation, thus being ready at all times for emergencies. By a system of valves the fire pumps can be changed over to the fresh water system if necessary, or in case of fire will operate both until the ar



INTERIOR VIEW OF MACHINE SHOP LOOKING SOUTH.

The fresh and salt water systems distribute through the manifolds throughout the plant, the former direct from the Spring Valley mains, the latter from a 16 by 9 by 12 inch Smith-Vaile fire pump, which will deliver 750 gallons per minute. This is governed by a Metz pump governor, so that it keeps a constant pres-

rival of the city's engines, when the latter will take fresh water, leaving the salt water for the shop force.

There is also in the power-house a 100 horse power induction motor driving a line shaft which operates a blower for the blacksmith shop fires, an auxiliary air compressor and an auxiliary hydraulic pump.

OIL SYSTEM.

The oil system is very complete, crude petroleum being the principal fuel throughout the works. The storage tank holds 7,000 barrels and is surrounded by a brick wall 80 by 55 feet, 9 feet high, forming a reservoir with cemented floor, which will contain the entire contents of the tank. One corner is walled off, forming a pumping room. Here is located a Goulds rotary pump operated by a five horse power motor and having a capacity of 250 gallons per minute. This is connected to the pipe lines so as to be used either to empty tank cars into the storage tank or pump oil into the supply tank at the power house. It will empty a car in twenty-five minutes or fill the storage tank (which will last about ten hours) in fifteen minutes. Four cars can be connected to it at one time. The supply tank is buried beneath one end of the power house. Above this are two duplex steam pumps arranged in duplicate. These pump the oil through a heater to the boilers. They also pump oil to the blacksmith and boiler shops, where it is used in the angle furnace, rivet heating furnaces and other fires.

MACHINE SHOP.

This building is a carefully designed steel structure, 400 by 110 feet, is unusually lofty for such buildings, and is elaborately lighted and ventilated. The tools have been carefully chosen to properly handle the heaviest marine and mining machinery as well as the finest and most accurate machine work. They were supplied by the Niles-Bement-Pond Company, and there is no machine shop in the country that contains larger tools or a more complete equipment. All large new tools have their own direct connected motor. Among these are a 24 by 16 foot vertical boring mill, four 8 foot vertical boring mills, a horizontal boring and milling machine of 14 feet horizontal travel by 8 feet vertical travel, a 60-inch by 40-foot heavy forge lathe, a large vertical planer, and many others.

Above the ground floor are two galleries on each side of the building. The lower galleries are each 125 by 25 feet, extending from the north end. The upper galleries are of the same width, extending the full length of the building. The lower ones are filled with small tools, vise benches, etc., as is the east upper gallery, the west being at present occupied by the electrical storeroom and workshop, office and the temporary draughting room of the works. In the remaining 275 feet not occupied by the lower galleries (that is, the south or erecting end) run two 10 and 15-ton electric overhead traveling cranes of 25-foot span, 22-foot lift. In the middle fifty feet, which is clear to the roof, runs a 20-ton crane the full length of the building. It has a lift of thirty feet. Besides these a 60-ton crane of the same type is to be installed in the south end, where the erecting shop is located. This will be above the 20-ton crane, and will have a 50-foot span, 45-foot lift and a 275-foot run. The 15, 20 and 60-ton cranes all have 5-ton auxiliary hoists.

The ground floor is paved throughout with red wood blocks, set on end in asphalt and coated over with tar and gravel.

The machine shop tool room is built into one side of the main building about midway in length. This is 30 by 60 feet, two stories high, encased on three sides, with the fourth separated from the main shop by wire netting only. It contains a complete equipment of the finest machines for making tools, and a large assortment on hand of all the tools necessary for a modern shop.

BOILER SHOP.

The boiler shop and foundry adjoin end to end, allowing space through the partition for the railroad track, which runs through the boiler shop close to this partition, and serves as an outlet for both. The shop is a thoroughly substantial, high, well-lighted building 250 by 184 feet. It also is paved with wooden blocks. Adjoining is the foreman's office, 14 feet by 14 feet 6 inches, raised eight feet above the floor, and so situated as to command a view of the entire shop. A toolroom 61 feet by 14 feet 6 inches is situated under and to one side of the office. It is separated from the shop by wire netting, the other three sides being cased in. There is also a room 45 by 30 feet, fitted with racks for bolts and rivets. The main shop has three overhead electric traveling cranes, one 60-ton, with 56-foot span and 41-foot lift; one 20-ton, 50-foot span and 41-foot lift and one 10-ton with 33 1-2-foot span and 30-foot lift. All have 5-ton auxiliary hoists.

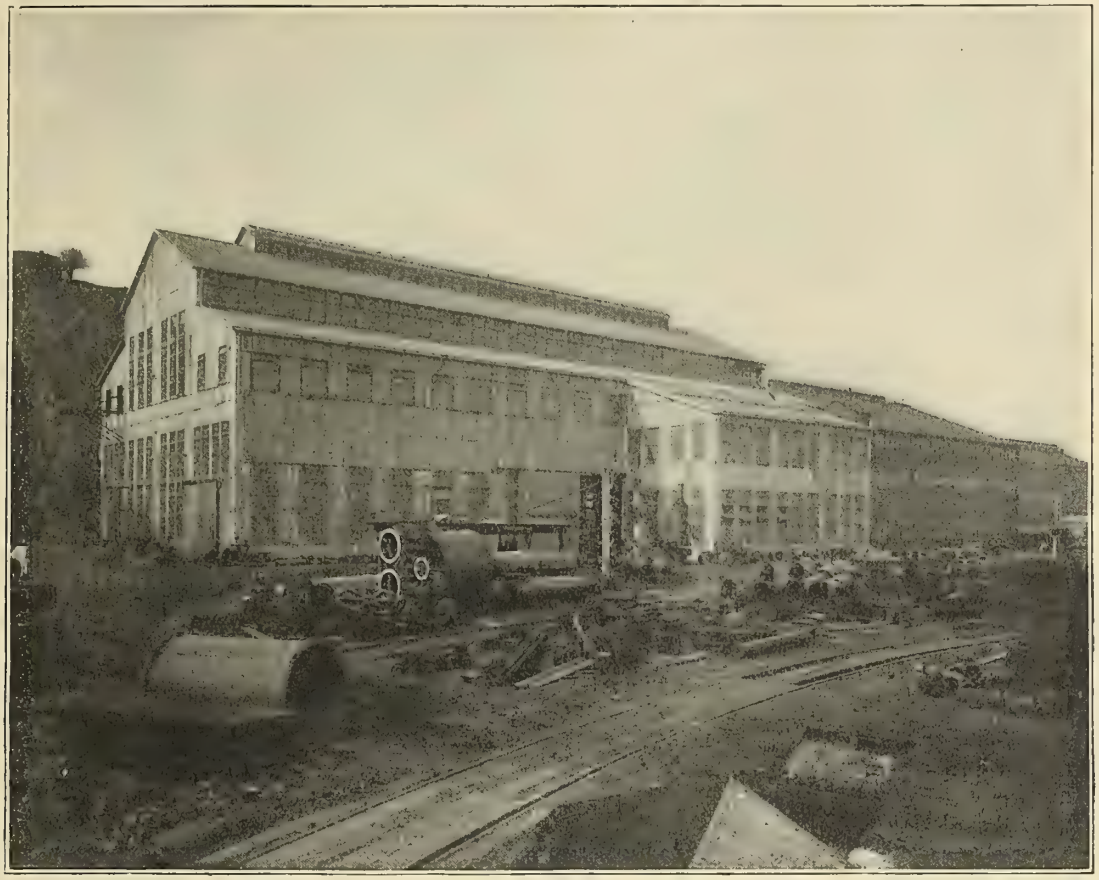
The tool equipment consists of bending rolls, hydraulic flanging presses, hydraulic riveters, air riveters, punches and shears, pneumatic hammers, and in short, everything to make up a modern boiler shop is provided. Among the principal machines are a large punch with a 60-inch jaw, capable of punching a 6-inch hole in a 5-8-inch plate. Here are also located 12-foot 6-inch rolls, capable of rolling a 1 1-4 inch plate. There is a gang drill for drilling large boilers, on which three men can operate at one time, and a large flange punch of the latest improved pattern for work on boiler heads.

Besides there are drills of all sizes and kinds, the latest improved types of bevel angle and plate shears, post jib cranes with hydraulic hoists, hydraulic flanging clamps and bending machines, bending slabs, five forges, rivet-heating furnaces, etc. Outside the building and alongside the railroad tracks are the plate racks, also tube racks 60 feet long by 80 feet high. Air is furnished the forges by a No. 8 Sturtevant steel pressure blower belted to the line shaft.

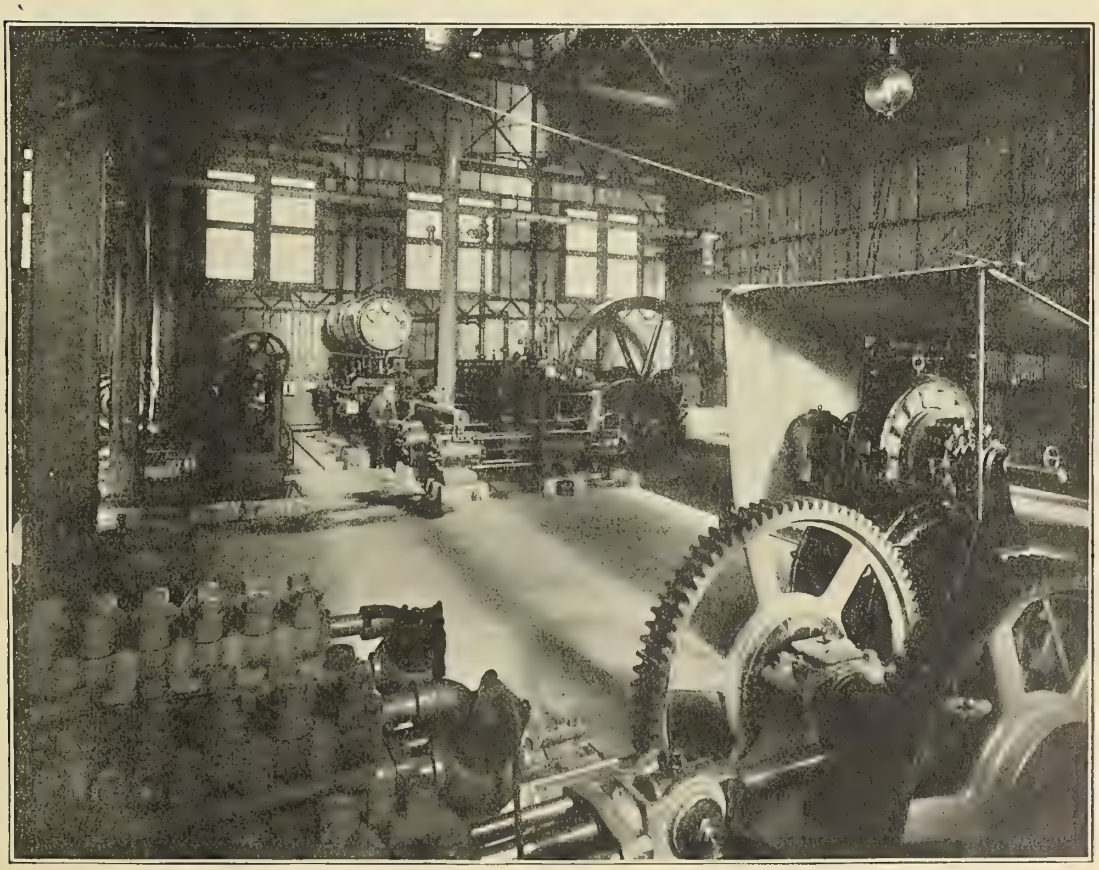
FOUNDRY.

This is a steel building covering an area of 250 by 200 feet. It is provided with two 30-ton electric cranes and one 10-ton electric crane, all equipped with 5-ton auxiliary hoists, besides various post jib cranes distributed throughout the shop. The principal crane has a lift of 40 feet. The building is well lighted and ventilated throughout.

The foundry equipment includes four cupolas for melting iron, with an aggregate capacity of 75 tons and a reverberatory furnace. The core department contains four core ovens, 12 by 18 feet, 14 feet high; one core oven 18 by 25 feet, 14 feet high; one small core oven with turret and shelves, and a cement core floor 40 by 100 feet. There is a large cupola deck having ample space for storing material for immediate use, while adjoining the cupolas is room for storing prac-



MACHINE SHOP.



INTERIOR OF POWER HOUSE.

tically unlimited quantities of pig iron and coke, which are easy of access. Under the cupola platforms are large bins with cement floor for storing loam. There is a large Chili mill for loam work. The blower plant consists of one Root blower, No. 6, geared to a 30-horse power motor, and one Root blower, No. 5, geared to a 20-horse power motor.

BLACKSMITH SHOP.

This shop is intended and designed to handle all work of that character for both machine and ship work. The building is of steel, 350 by 65 feet, and is especially designed as regards ventilation. The sides and ends are made up entirely of sliding doors, which can be moved in either direction, securing a cool shop in the hottest weather, and allowing large pieces to be swung in easily or carried out at any point. The following are among the tools included: Hydraulic press for making and welding bands and for drop forging, electric beveling machine for angle iron, one 3-ton steam hammer, one 2-ton steam hammer, one 1-ton steam hammer, one 1,500-pound steam hammer, two 1,100 pound steam hammers, one belt hammer, two 20-ton steam jib cranes, two 10 and 6-ton wood jib cranes, one 10-ton steel jib crane, one forging furnace, from which the waste gases are utilized in a steam boiler for supplying steam to the cranes.

The shop also contains bending slabs 45 by 45 feet, and has a full equipment for forging cranks and heavy shafting, shipsmithing, machine forgings, etc. There is room for forty-five fires arranged along the center and on either side.

PIPE SHOP.

This shop immediately joins the boiler shop on the opposite end from the foundry and extends north to the power house and copper shop. These form the ends, the sides being open. The roof covers a space of 133 by 186 feet, which is not excessive when we take into consideration the fact that the Risdon Iron Works make more sheet pipe than any other single firm in the world. This shop is also used extensively for doing light pipe work, making smokestacks, dredger buckets, etc.

SHIP TOOL BUILDING.

The ship tool building, containing also the mold loft, has been very carefully designed, and is perhaps the most thoroughly and elaborately equipped for saving labor and turning out work rapidly of any in America.

It is of steel, 433 by 85 feet wide, with an additional 15 feet of overhanging shed running the full length. This side is open, the columns being 40 feet apart and facing the shoreward ends of the shipbuilding ways.

The mold loft floor, having a perfectly clear expanse of 433 by 85 feet, is probably the largest in America. Being supported every ten feet by latticed girders, five feet deep, it is practically rigid.

The most noticeable feature of the ship tool shop is the elaborate system of trolleys and crawls for distributing material and handling it at the machines. There are 24 crawls, ranging from 6-foot to 17-foot span, and supplied with cross trolleys for handling plates and angles, nine 3-foot gauge trolleys running on the through tracks for distributing material, and two narrow gauge trolleys for handling angle bars at the double angle shears and angle planer. This shop is completely equipped with new tools furnished by Hillis and Jones and others.

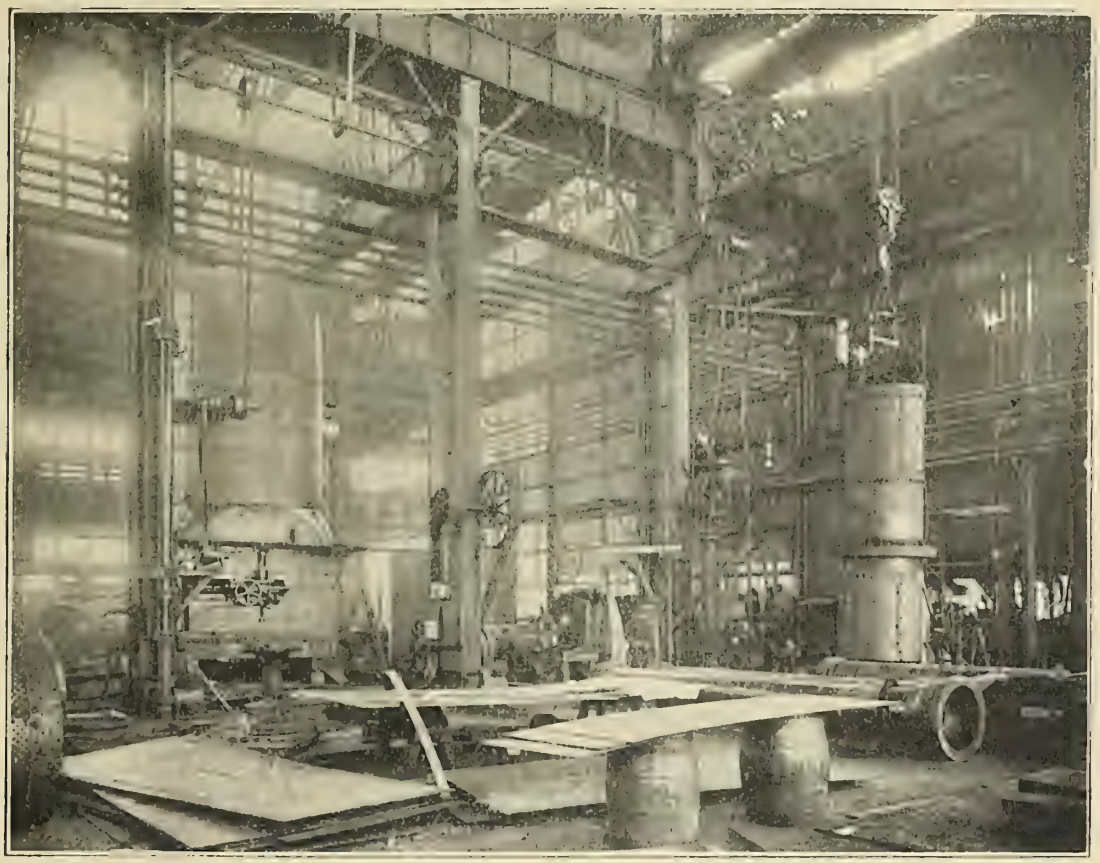
Among the larger ones we have a 30 foot 2 inch plate bending roll, operated by a 35 horse power A. C. motor, and a 15 horse power A. C. motor for raising and lowering the top roll. An hydraulic keel plate bender 24 feet 8 inches long 8 feet wide, taking 4-inch material; one 48-inch heavy combined punch and shear, motor driven; one 42-inch heavy double punch, motor driven; one 36-inch heavy combined punch and shear, motor driven, and six smaller single belt driven punches or shears. One set of mast bending rolls 12 feet 2 inches wide, motor driven; one set of straightening rolls 86 inches below housing, motor driven; an angle iron planer for any length and any degree of straightness; two plate planers 30 feet long, motor driven, and fitted with hydraulic clamping jacks; one large combined horizontal punch and beam bender; one medium sized horizontal punch, radial countersinkers, drill presses, etc., over which are two lines of track carrying twelve crawls of 11-foot span each. Completely around these runs a through track carrying four 3-foot trolleys for distribution. Just outside this oval are 6-foot gauge tracks for the four small single ended punches or shears and the two 30-foot plate planers; 13-foot gauge tracks for the mast rolls and straightening rolls, and clear across one end are two 17-foot gauge tracks completely covering the large 30-foot bending rolls, which will take a plate two and a half inches thick, and the hydraulic keel bender which will bend a plate four inches thick. Material is brought in on a 3-foot track running the entire length of the overhanging shed and extending beyond enough to take from the gantry crane running over the plate racks. The 3-foot track is twenty-three feet from the ground, allowing the locomotive trains to swing underneath the railroad track, paralleling the trolley just outside the shed. All the other trolley tracks are fourteen feet from the ground. All the crosstracks run out to meet this through track, so that material can be taken to any machine in the shop, or the finished work removed without disturbing any other machine, even when all are in use. Besides the machines mentioned above, there are two radial counter-sinking and drilling machines working over a long roller table, and various smaller drill presses.

MISCELLANEOUS BUILDINGS.

Besides the principal buildings mentioned above there is a completely equipped joiner and ship pattern shop, two stories high, 200 by 100 feet, at present supplying all the pattern work; a copper shop, 110 by 45 feet; a brass foundry 80 by 110 feet; a two-story pattern storage warehouse 80 by 170 feet; miscellaneous warehouses aggregating 132 by 200 feet; an emergency hospital 23 by 75 feet; a stable 35 by 123 feet, and a Babbitt melting and fitting shop 16 by 25 feet.

WATER FRONT.

The wharfage facilities include nine wharves, with frontage as follows: No. 1, 387 feet long; No. 2, 300



BOILER SHOP.

MIDDLE BAY OF FOUNDRY.

feet long; No. 3, 48 feet long; No. 4, 300 feet long; No. 5, 138 feet long; No. 6, 235 feet long; No. 7, 42 feet 9 inches long; No. 8, 300 feet long; No. 9, 150 feet long. The total frontage is 1,900 feet. All are connected by railroad tracks, and have hydraulic, compressed air and electric connection with the power house, besides salt and fresh water plugs. The 100-ton shear legs are located on wharf No. 1. Besides the main lift of 100 tons, there is a masting hoist of twenty tons capacity. The shear legs have an overhang of thirty-six feet, a spread of forty-five feet, and a clear lift of ninety feet.

SHIP YARDS AND WAYS.

There is room at present for building five vessels 600 feet long and one 700 feet long, or a greater number of smaller vessels occupying the same length. Provision is made for handling all material in the course of construction by overhead traveling cranes.

PLATE RACKS.

These are located along the ship ways and extending up to the blacksmith shop and the ship tool building. They will be covered by a gantry crane, with a span of sixty feet, running their entire length and delivering material to either the blacksmith shop or the trolleys of the ship tool building. Railroad tracks pass through them underneath the gantry, which will be high enough to allow the locomotive cranes to pass underneath.

LAUNCHES.

The Risdon Iron Works is well supplied with launches, having three operated by gasoline, for service between the Potrero works and the downtown office and branch. They are fifty-five feet, fifty feet and thirty-six feet long, respectively, and are very swift, the largest being equal in speed to anything on the bay of the same dimensions.

EXPANSION.

The total ground owned is thirty-five acres, while the aggregate area under cover at present is approximately eight acres, with another acre provided for in the near future. This leaves twenty-six acres for ship yard, storage and future expansion. The total floor area, with what is provided for, amounts to ten and one-half acres.

CITY OFFICE.

The new city office and branch machine shop is a handsome building located at the corner of Steuart and Folsom streets, near the Folsom street wharf. It contains a storeroom for made-up stock, an exhibition of sample machines, and a small shop for hurried repairs and other work of similar nature.

THE GROWTH OF THE RISDON.

The Risdon Iron and Locomotive Works, though entering upon a remarkable era of expansion, so extensive and divergent that the old landmarks of its development are quite lost sight of, is yet one of the oldest and best established manufacturing institutions on the Pacific Coast. In the early days, when mining was the prime source of wealth on this coast, its machinery was the most important manufactured. The Risdon works, being a pioneer in this field, has grown up with it, expanding as it developed, and contributing its full quota of original inventions, improved forms and labor saving devices, which have made California's methods a model of mining on a large scale as a practical science the world over. Though this will always remain an extensive and lucrative field, other lines are developing into even greater magnitude—shipbuilding, for instance. Into this the Risdon is prepared to bring the same energy, improved methods and conscientious workmanship which have built up its remarkable trade in the former branch.

The work which this company is now prepared to do lies in five broad fields, each complete in all its branches. These are shipbuilding, marine engineering, mining machinery, structural iron work and miscellaneous engine and machine work.

SHIPBUILDING.

In the first the equipment is entirely new and up-to-date, and includes facilities for building six steel vessels at once, 600 or 700 feet long and up to 80-feet beam, or a larger number of smaller vessels. There are also provided nine wharves for the repair and fitting out of steamers.

MARINE ENGINEERING.

The second department is that of marine engines, high pressure, condensing, compound, triple or quadruple expansion; marine boilers of the latest improved Scotch, locomotive or water-tube type, for burning either coal or crude petroleum; condensers, feed pumps, distilling apparatus, evaporators, refrigerating and ice machines, steering engines, windlasses, winches, coal and ash handling machinery, and in fact, all that goes to operate an ocean-going steamer of the largest and most elaborate type.

MINING MACHINERY.

The third or mining machinery class is so broad that only a bare mention can be made of the various types. For mining proper there are hoisting and pumping engines, steam, hydraulic and portable, and rock drilling, tramway and ventilating machinery. For ore reduction there are smelting furnaces for silver, lead and copper, reverberatory and mechanical roasting furnaces, revolving and kiln ore dryers, stamp mills, roller mills, concentrators and chlorination works. Among the specialties in this line manufactured by the Risdon are Bryan roller mills, Johnson concentrators, steel whims, Hoskins's giants, Wright calcining furnaces, Pelatan clerici process machinery and Evans' hydraulic elevators. Among the different methods of mining, one in particular has become of paramount importance in the last few years. It is working the gold bearing river beds by means of bucket and even caisson dredgers.

The Risdon has built a great number of these, and holds the exclusive rights for building the R. H. Postlethwaite dredge, undoubtedly the most successful one on the market. As evidence of this might be stated the fact that four years ago there was no successful dredger working in California, although many were left as failures on the banks of rivers throughout the state.

Since the first Risdon dredger was built on the Feather river there have been over thirty of them made, and the Risdon is now building nine of these

machines. The dredgers have not only been used in California, but are in operation all over the western states and among the gold districts of Africa, Alaska and Mexico.

STRUCTURAL IRON WORK.

In the fourth class—that of structural iron and steel work—the Risdon has contributed to the most important recent building operations of San Francisco, notably the Union Depot, or ferry building, and the Claus Spreckels building. Mention should also be made of the Spreckels Sugar Company's plant, at Spreckels, Monterey County, California. The main building is 582 by 103 feet, six stories high and contains over 3,600 tons of structural steel.

been built extensively for many years, later examples being three 3,000 horse power water wheels directly connected to polyphase alternators for the Bay Counties Power Company. Another important branch is that of hydraulic steel pipe building, of which they are the most extensive builders in the world.

The miscellaneous group is too extensive and diversified to allow of specifying more than a few types. For instance, Corliss engines, Risdon air compressors, Heine safety water-tube boilers, Smith-Vaile pumps, all sorts of manufacturing and special machinery, boiler fixtures, all kinds and sizes of valves, pneumatic and hydraulic tools.

BLACKSMITH SHOP.

ENGINE AND MACHINE WORK.

The last class, comprising miscellaneous engine and machine work, contains many diverse branches, some, notably sugar machinery and hydraulic machinery, being almost of sufficient importance and magnitude to rank with the main groups. The former includes most of the machinery used on the sugar plantations of the Hawaiian Islands, consisting of crushers, vacuum pans, filter presses, settling tanks, etc., besides engines, trash burning boilers, pumps, water wheels, motors, etc.

In hydraulic machinery the Risdon is a pioneer, having built the real prototype of the modern tangential water wheel with re-action buckets, frequently called the "Pelton type" water wheel, which has

INDUCED DRAFT ON STEAMSHIP NECKAR.

The steamship *Neckar*, of the North German Lloyd Company, which recently made her maiden voyage to this country, is built with the idea of reducing the expenses of operation to the minimum consistent with good engineering. She is of the intermediate type of freight and passenger steamer, and was built by J. C. Tecklenborg, of Geestemunde, Germany. She is 500 feet long between perpendiculars, 58 feet extreme beam, 37 feet deep and of 11,200 registered tons. At a load draft of 28 feet the displacement is about 16,250 tons.

Means are provided for quickly handling the cargo on this ship. There are eight cargo hatches, four forward and four aft, and four steel masts stepped between hatches Nos. 1 and 2, 3 and 4, 5 and 6, and 7 and 8. The

fore and jigger masts are equipped with two derrick platforms, one on the forward and one on the after side of the mast. The main and mizzen masts are fitted with one derrick platform each, while two other platforms are located at the break of the bridge deck, one forward and one aft, and each platform has sockets for four cargo derricks. Thus hatches Nos. 1, 4, 5 and 8 have four derricks each, and the other hatches eight derricks each. At each mast are four steam winches, making a total of sixteen winches and thirty-two derricks.

Plain but roomy cabins for the first-class passengers are located amidships in a two-deck bridge house.

The propelling machinery consists of two sets of four cylinder quadruple expansion engines, with cylinders 23.80, 33.88, 48.03 and 71.25 inches in diameter by 51.13 inches stroke. The high-pressure cylinder is forward, the low-pressure second, the second intermediate third, and the first intermediate at the after end. The sequence of cranks is, looking aft, high, second intermediate, low and first intermediate, the crank angles being according to the Schlick system of balancing. The crank webs of the end cylinders have counterbalance discs. These two cylinders have piston valves, that on the high being forward and that on the intermediate being on the aft end of the engine. Slide valves are fitted to the other cylinders, placed facing each other, and all valves are actuated by Stephenson link motion. This arrangement gives a compact and well balanced engine. The cylinders are separate castings mounted on cast iron A frame housings, and these housings are braced to each other at the top by cast iron box girders. The cylinders are secured to each other by rods screwed into lugs on the cylinders. The condenser is cast in the frame of the first and second intermediate cylinders.

Steam is supplied by three single and two double end boilers, and it is in this department that the largest coal economy has been attained. Two of the single end and the two double end boilers are fitted with Ellis and Eaves' system of induced draft. The other single end boiler, which is located in a recess of the cross bunker, is not fitted with this system, as it is often used as a donkey boiler when in port.

The dimensions of the boilers and heaters are:—

	Single End.	Double End.
Diameter	14 ft. 3¼ in.	14 ft. 3¼ in.
Length	11 " 2⅝ "	20 " 9 "
Number of furnaces	3	6
Inside diameter of furnace	39⅜ in.	39⅜ in.
Number of tubes	376	752
Diameter of tubes (plain)	2¾ in.	2¾ in.
Heating surface	2370 sq. ft.	4780 sq. ft.
Grate surface	59 "	118 "
Total H. S.	16,670 sq. ft.	
" G. S.	413 "	
Number of tubes in heater	342	
Size of tubes	2¾ in. O. D. No. 14 B.W.G.	
Length of tubes	5 ft. 10½ in.	
Coal burned, approx	1050 tons.	

The gases on leaving the smoke boxes of the boilers, which are fitted with the induced draft, pass upward through the air-heating boxes, and from these direct to the fans by as short a route as possible, the fans discharging directly into the funnel, so that there is as little loss as possible due to tortuous passages; and indeed it has been found that the vacuum in the smoke-box is the same as at the fan inlet.

The form of heater as used on the *Neckar* is composed of a number of vertical tubes, through which the products of combustion pass. As it is desirable to have nearly the same amount of heating surface in this heater as in the boiler tubes, and as the vertical space is limited, these heater tubes were made of larger diameter than is customary in installing this system. Owing to the low specific heat of air it is found that by bringing it into close contact with the surface from which the heat is derived it is very easy to raise its temperature even with comparatively short tubes. The above object is gained by a very simple device, which in practice is found to be thoroughly satisfactory. At a point about one-quarter the length of the heating tubes a diaphram plate is placed. The holes in this plate through which the tubes pass, do not fit the tube, but are 1-2 inch larger than the outside diameter of the tube. The air can circulate freely through the upper portion of the tubes above the diaphragm plate, but to reach the valves in the furnace it is drawn in thin annular streams round the heated tubes, from which it takes up the heat at once.

As the heated air is drawn from the ends of the heating boxes, there would be a tendency for the air entering the annular spaces at the corner of the box farthest from its exit to take the shortest course in a diagonal direction across the tubes. This is prevented by placing vertical division plates between the tubes, so that no matter where the air enters it is forced to travel over every portion of the heated surface before escaping.

On leaving the heating boxes the air is led down passages on both sides of the smoke-boxes and enters the fire through the regulating valves on the furnace front. Five valves are here provided, two of which communicate with the ashpit direct, and three with the furnaces above the bars, the air passing through perforated baffle plates in the ordinary way. The two upper side valves are only required when burning bituminous coal very rich in hydro-carbon, in which case an excess of hot air is necessary to insure perfect combustion of the gases in the combustion chambers. A cast iron ashpit door is fitted to the lower portion of the front; this door is perforated with a number of 1 1-4 inches holes, so as to allow the entrance of a certain portion of cold air under the bars. Experience has shown that any tendency which may exist for the bars to become red-hot and burn down is entirely obviated by raising them about 2 inches higher at the bridge than at the furnace front, which is just the opposite of the usual practice.

The fans are placed athwart-ships in such a position as to discharge directly into the funnel, and fitted with expanding outlets which obviates all possibility of back pressure on the fans, and greatly reduces the power required to drive them. The fan engines are in the engine room, in a recess above the cross bunker, the connection to the fans being made by means of shafting provided with flexible couplings to compensate for any twisting which may take place due to the expansion of boilers and casings. The engines made by Messrs. Thwaites Brothers, Ltd., of Bradford, are of the compound single acting type, the consumption of steam is small; they are practically noiseless and require very little attention.

The *Neckar* left Bremerhaven for her maiden voyage across the Atlantic on May 4, 1901, at 12 o'clock, and arrived in New York on the evening of May 15th without meeting rough weather. On this trip a test of the draft system was made by experienced engineers, and the efficiency of the system may be seen by noting the rise in temperature of the air entering the furnaces through the heaters. Taking the average for the voyage, it is seen that the air was raised from 139 degrees Fahrenheit to 314 and 327 degrees, and that the temperature of the escaping gases was reduced from 526 to 400 degrees. The coal burned on the voyage was 1,050 tons, and the average indicated horse-power was 6,000, making the pounds of coal per I. H. P. per hour 1.62. The mean draft for the trip was 21 feet 7 inches, and the average speed was 14.1 knots.

Log of induced draft system on steamship *Neckar*, voyage No. 1, Bremerhaven to New York.

Boiler pressure	208 lbs.
Revolutions of fan engines, port	191
" " " starboard	194
Vacuum by water gauge	
At fan inlet	1⅝ in.
" suction forward port	1¼ "
" " " starboard	1¼ "
" " aft port	1¼ "
" " " starboard	1¼ "
Grates over	7-16 "
" under	5-16 "
Velocity of air in feet per minute	
Ashpit old fires	667 ft.
" new fires	730 "
At entrance of air heaters	230 "
Temperature in degrees Fahrenheit	
Air entering fans, old fires	314 deg.
" " " new "	327 "
At fan suction forward	526 "
" " " aft	526 "
Escaping gases in funnel	400 "
Air at entrance of heater	139 "

Design of engines of varying powers from one set of drawings.—In connection with the articles on this subject by Professor H. C. Sadler, we are in receipt of a communication from M. J. A. Normand, of Havre, France, in which he calls attention to an article by him upon the same subject, and published in *Engineering*, Vol. LX, p. 54.

Shipbuilding Returns. — During the six months ended December 31, 1901, there were built in the United States and officially numbered by the Bureau of Navigation 717 rigged vessels of 154,073 gross tons compared with 568 rigged vessels of 179,229 gross tons for the corresponding six months of 1900. Canal boats and unrigged barges are not included. The principal decline, 19,752 tons, is on the Atlantic seaboard, and is attributable to work on several large ocean steamers, which will be completed during the coming six months. Included in the six months figures are 38 vessels, each over 1,000 tons, and aggregating 103,832 tons. Of these 14 steel steamers, aggregating 52,310 tons, were built on the Great Lakes. Four are for the seaboard, two banana steamers, *Watson* and *Buckman*, each of 1,820 tons, the *Hugoma*, 2,182 tons, and the *Minnetonka*, 5,270 tons. The *Minnetonka* will be cut in two to pass the canals. On the seaboard 15 wooden schooners of 24,864 tons were built, five steel steamers for the coasting trade, and one steel ferry boat, aggregating 20,964 tons. Square rigged vessels are the steel ship *William P. Frye*, 3,374 tons, and two barkentines on the Pacific, aggregating 2,310 tons.

THE THEORETICAL AND PRACTICAL METHODS OF BALANCING MARINE ENGINES, I.

BY NAVAL CONSTRUCTOR D. W. TAYLOR, U. S. N.

A Comprehensive Abstract of the Prize Paper Presented Before the Society of Naval Architects and Marine Engineers, November, 1901.

The paper opens with introductory paragraphs on sources of vibrations other than the engines, on certain elementary features of the vibrations of ships, on the present status of engine balancing, and on the effect of slack bearings or improper valve setting. The author then takes up his main subject as follows:—

GENESIS OF UNBALANCED FORCES.

6. Let us consider first an engine with a single cylinder. If steam is in the cylinder, but the piston is not moving, the pressure upon the piston and the pressure upon the cylinder head are equal and opposite. These pressures neutralize one another through the engine framing, and there is no external or unbalanced force communicated to the engine supports. If, however, the piston, with its attached weights, is moving and being accelerated, that portion of the steam pressure necessary to accelerate it is absorbed in giving energy to the moving parts, and hence is not transmitted to the engine framing. It follows that the pressure on the cylinder head which tends to move the framing in one direction is only partially balanced by that portion of the steam pressure upon the piston which is transmitted to the engine framing via the piston rod, connecting rod, and crank shaft. It is obvious, then, that the unbalanced forces developed when a single-cylinder engine is revolving are equal and opposite to the forces necessary to accelerate or retard the moving parts as the engine turns over.

RESULTS OF INVESTIGATION OF SINGLE-CYLINDER ENGINE.

7. In Appendix A* will be found a detailed investigation of the geometry and mechanics of the motion in the case of a single-cylinder engine. Referring to these we find that the weights of the moving parts of a single-cylinder direct-acting engine are equivalent to a reciprocating weight W, which moves with the crosshead and a revolving weight L, which is concentrated at the crank pin axis.

That if r denotes the crank arm radius (equal to one-half the stroke) and θ the angle made by the crank radius with the direction of the cylinder axis, we have for a vertical engine an unbalanced force denoted by Q, due to the reciprocating weight W, and unbalanced vertical and horizontal forces denoted by V and H, due to the revolving weight L. If R denotes revolutions per minute, the expressions for Q, V, and H are as follows:—

$$Q = .000341\, rR^2 W \left\{ \cos\theta + \frac{\cos 2\theta}{n} \right\} \dagger$$

$$V = .000341\, rR^2 L \cos\theta.$$

$$H = .000341\, rR^2 L \sin\theta.$$

Formulæ for Forces and Moments in Multi-Cylinder Engines.

8. Suppose, now, we have k parallel cylinders of

*Omitted.

†In this equation n equals the ratio of connecting rod to crank lengths.

equal stroke directly connected to the same shaft. Suppose that their axes are distant l_1, l_2, l_3,...l_k feet, respectively, from a fixed point on the shaft. Suppose their cranks are set at angles a_1, a_2, a_3,...a_k with a fixed radius of the shaft. Let w_1, w_2, w_3,...w_k denote the reciprocating weights, L_1, L_2, L_3 . . . L_k the revolving weights, r the common crank arm, R the common revolutions per minute, and θ the angle made by the fixed shaft radius (from which a_1, a_2, etc., are measured) with the plane through the axes of the cylinders.

We need to determine the total or resultant unbalanced forces set up because of the rotation of the engine. Since the unbalanced forces in the various cylinders are not all in the same line, unbalanced moments will also make their appearance, and these, too, we need to determine.

Consider, first, the reciprocating weights. Denote the unbalanced forces due to them in the respective cylinders by q_1, q_2 . . . q_k. Evidently from the results demonstrated in Appendix A we have:—

$$q_1 = .000341\ rR^2w_1 \left\{ \cos(\theta + a_1) + \frac{1}{n} \cos 2(\theta + a_1) \right\}.$$

Similarly we have

$$q_2 = .000341\ rR^2w_2 \left\{ \cos(\theta + a_2) + \frac{1}{n} \cos 2(\theta + a_2) \right\},$$

and so on. It is convenient in determining the complete effect of the forces to use the ordinary device of applying, at the point through which moments are taken, two equal, opposite and parallel forces for each unbalanced force considered. Each unbalanced force is thus reduced to a force acting through the point about which moments are taken, and a couple whose arm is the distance from the point about which moments are taken to the line of action of the unbalanced force. If we take moments about O and denote the moment of the couple, due to w_1 by m_1 we have:—

$$m_1 = q_1 l_1 = .000341\ rR^2 w_1 l_1 \left\{ \cos(\theta + a_1) + \frac{1}{n} \cos 2(\theta + a_1) \right\}$$

$$m_2 = q_2 l_2 = .000341\ rR^2 w_2 l_2 \left\{ \cos(\theta + a_2) + \frac{1}{n} \cos 2(\theta + a_2) \right\}$$

and so on.

The expression .000341 rR^2 common to all our formulae may be conveniently replaced by C.

It is also convenient at this stage of analysis to separate the forces into two parts. That part varying as cos $(\theta + a)$ is conveniently called the primary force, and that varying as cos 2 $(\theta + a)$ is conveniently called the secondary force. Corresponding to the primary and secondary forces we have similarly the primary and secondary moments. Let Q_1 denote the resultant primary force due to all the cylinders. Let Q_2 denote the resultant secondary force due to all the cylinders. Let M_1 denote the moment of resultant primary couple due to all cylinders. Let M_2 denote the moment of the resultant secondary couple due to all the cylinders. The forces being considered are all parallel, being those due to reciprocating weights, and their resultants are readily written down from well-known principles of mechanics.

INTRODUCTION OF GRAPHIC METHODS.

9. From the above somewhat formidable looking expressions it is possible to calculate the resultant unbalanced forces and moments of unbalanced couples due to any known system of cylinders at any point of the revolution of the shaft. These expressions, however, are entirely too complicated to be of much value when the investigation of measures of amelioration is undertaken. Fortunately, the case is one to which graphic methods are peculiarly adapted.

Referring to Fig. 1 Ox is the direction of the cylinder axes $xOA=\theta$. Draw OC_1 parallel to crank No. 1 and such that to a suitable scale $OC_1 = w_1$. Similarly draw OC_2, OC_3, OC_4, representing in direction and length the other cranks and reciprocating weights. Four cylinders are represented in the figure, but the process is applicable to any number.

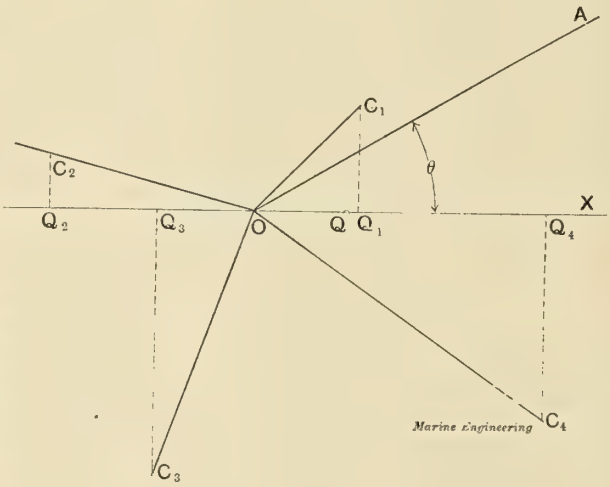


FIG. 1.

Draw the perpendiculars C_1Q_1 C_2Q_2, C_3Q_3, C_4Q_4.

Evidently $OQ_1 = w_1 \cos(\theta + a_1)$

$OQ_2 = w_2 \cos(\theta + a_2)$, and so on.

The algebraic sum of OQ_1, OQ_2 . . . OQ_4 is OQ, which then represents in magnitude and direction the resultant primary force.

Referring now to Fig. 2, instead of drawing all the cranks from O draw Ox and OC_1 as before. Then from C_1 draw a line C_1C_2 parallel to the second crank and representing in length its reciprocating weight. Draw from C_2 a line C_2C_3 similarly representing the third crank, and from C_3 draw C_3C_4 for the fourth crank. Drop the perpendicular C_4Q upon Ox, and OQ in Fig. 2 is exactly the same as OQ in Fig. 1, $OC_1C_2C_4$ in Fig. 2 is called the primary force polygon, and the angle β or AOC_4 is constant, whatever the value of θ. Evidently, if for OC_1, OC_2, and so on, we substitute a single crank at the angle β with OA, driving a reciprocating weight, represented by the length of OC_4, then, as regards primary reciprocating forces, the single weight on the single crank is equivalent to the system of four weights on four cranks from which it was deduced. The line OC_4 is called the closing line of the primary force poly-

gon. Clearly, if there were a fifth crank in the combination, parallel to C_4O and driving a reciprocating weight represented by the length C_4O, there would be no resultant primary force at any point of the shaft's revolution. In other words, the engine would be perfectly balanced as regards primary force.

In practice, when drawing a primary force polygon, it is convenient to make OA correspond with a crank radius, and measure all other crank angles in the direction of rotation from the direction of this crank. I usually use the forward crank radius as the direction to which to refer all angles.

Exactly in the same manner as the primary force polygon has been determined, it is possible to determine and delineate a primary couple or moment polygon, and the secondary force and couple polygons.

In drawing the secondary force polygon the weights are, of course, $\frac{I}{n}$, those used in the primary force

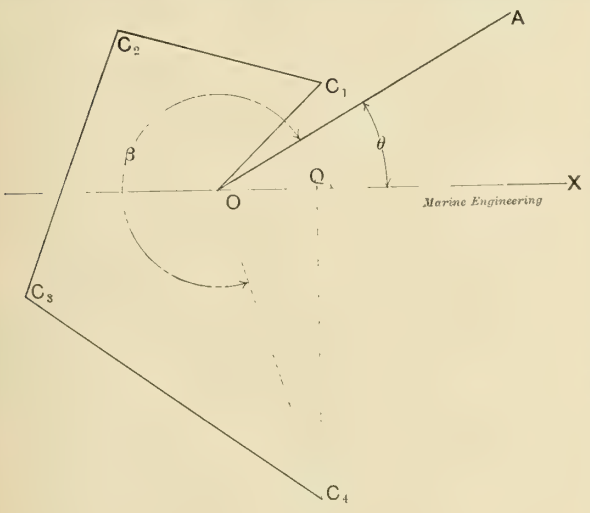


FIG. 2.

polygon, and the angles are doubled. This involves drawing angles greater than 360 degrees, which can, of course, be readily done.

When it comes to the couple or moment polygons, the lengths of the sides represent the moments of the couples, or the products w_1l_1, w_2l_2, etc. It is necessary, when considering actual engines, to choose a convenient point from which to measure l_1,l_2, etc., or, in other words, about which to calculate the moments of the couples. I find it convenient to use the point where the after cylinder axis intersects the shaft axis.

TREATMENT OF REVOLVING WEIGHTS.

11. So much for the reciprocating weights. The forces due to them are all parallel to the cylinder axes —vertical in the case of a vertical engine and horizontal in the case of a horizontal engine. When, however, we consider revolving weights, we find that, for a single weight L, the forces V and H, parallel and perpendicular, respectively, to the cylinder axis, are given by the formulae:—

$$V = CL \cos \theta$$
$$H = CL \sin \theta.$$

Where, as before, $C = .000341 \pi R^2$.

It is to be noted that these revolving forces are altogether primary. When proceeding from the case of a single cylinder to that with a number of cylinders acting on one shaft, the steps in connection with revolving weights are exactly the same as for reciprocating weights, and lead us to force and moment polygons for the revolving weights, both of which are primary only. It is to be noted that the closing line of a force polygon for revolving weights represents a revolving weight.

MINOR OR SECONDARY WEIGHTS.

12. I have now shown how to determine completely the resultant unbalanced forces and moments, at any point in the line of the shaft, due to any number of cylinders, their pistons, connecting rods, etc.—what may be called the main weights of the engine. There are, however, other moving weights which it is necessary to take account of—such as the valves, air pump gear, bilge pump gear, when fitted, etc.

In Appendix B, I have described and shown in detail methods of handling typical weights—valve gear, etc.—and it is believed that a careful study of the methods applied in Appendix B will enable the student to determine proper results in any ordinary case. There is no satisfactory method for handling radial valve gears, because such gears do not give harmonic motion. The most satisfactory method for such gears is to determine an approximate harmonic motion for them and work with that. The exact method is, of course, to determine graphically the motion of the valve, and then its velocity and acceleration; but even after this is done we are unable to satisfactorily balance such gears with weights which have harmonic motion.

CONDITIONS ESSENTIAL TO BALANCE

15. I come now to the question of balancing engines so as to reduce or extinguish entirely unbalanced forces. The methods previously explained will always enable us to determine whether or not an engine is balanced, and modifications of them will be found very useful when searching for methods to obtain a balance. I shall consider, primarily, the usual type of marine engine, the "vertical inverted," where the cylinders are arranged in line above the shaft. There are four conditions which must be fulfilled in a perfectly balanced engine.

First. As it revolves the combined center of gravity of the moving reciprocating weights must remain at a constant distance from the axis. When this is the case there can obviously be no resultant inertia forces, and hence no external force caused by the motion of the reciprocating weights.

Second. If we substitute for each moving reciprocating weight another one proportional to the product of the weight by its distance parallel to the shaft from a fixed point on the shaft axis, the center of gravity of this derived system of weights must remain at a constant distance from the axis as the shaft revolves.

When this is the case and the first condition is complied with, there can be no external couple due to reciprocating weights.

Third. The center of gravity of all revolving weights must be in the shaft axis.

When this is the case there can be no external force due to revolving weights.

Fourth. If for each revolving weight we substitute a weight proportional to the revolving weight, multiplied by its distance parallel to the shaft from a fixed point on the shaft axis, the center of gravity of this derived system must be in the shaft axis.

When this is the case and the third condition is complied with, there can be no couple or moment from revolving weights.

The above essential conditions for perfect balance have been known for years. It is evident that if all the force and moment polygons, as explained by me, are closed, the four conditions are fulfilled—otherwise, they are not fulfilled. It is evident, too, that if the four conditions are fulfilled for uniform rotation, they are necessarily fulfilled for non-uniform rotation.

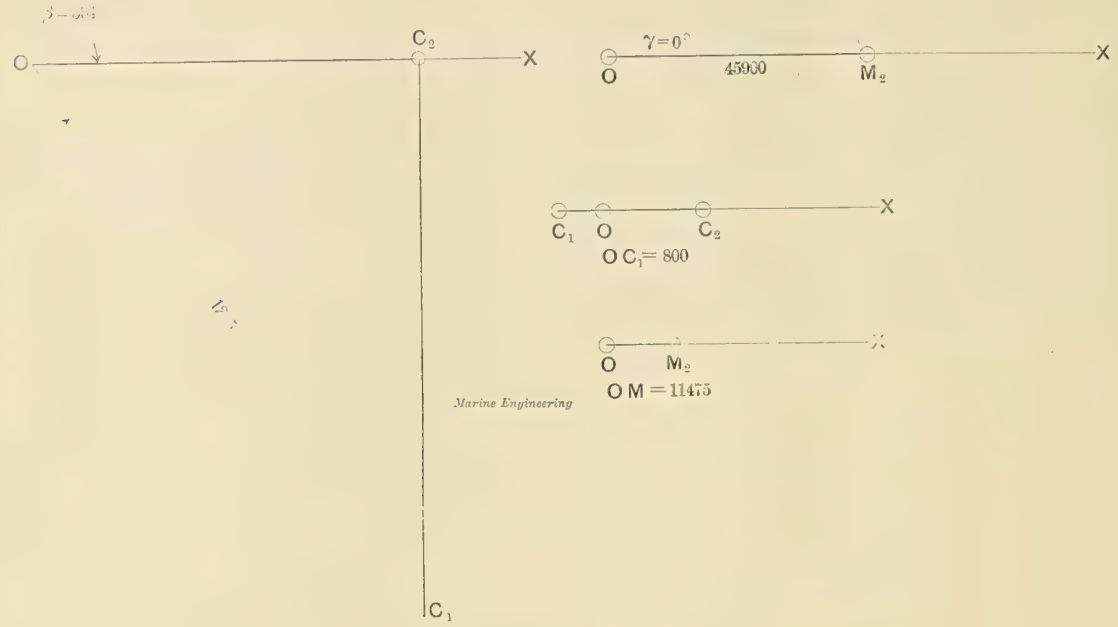


FIG. 3, CHARLESTON POLYGONS.

FORCE AND MOMENT POLYGONS FOR ACTUAL NAVAL ENGINES.

17. It is evident from what has gone before, that the more sides to our force and moment polygons the more readily they can be closed by manipulating weights and crank angles. That is to say, the more numerous the cranks of an engine the more readily it can be balanced without using special balance weights, which should be avoided where practicable. Also, for

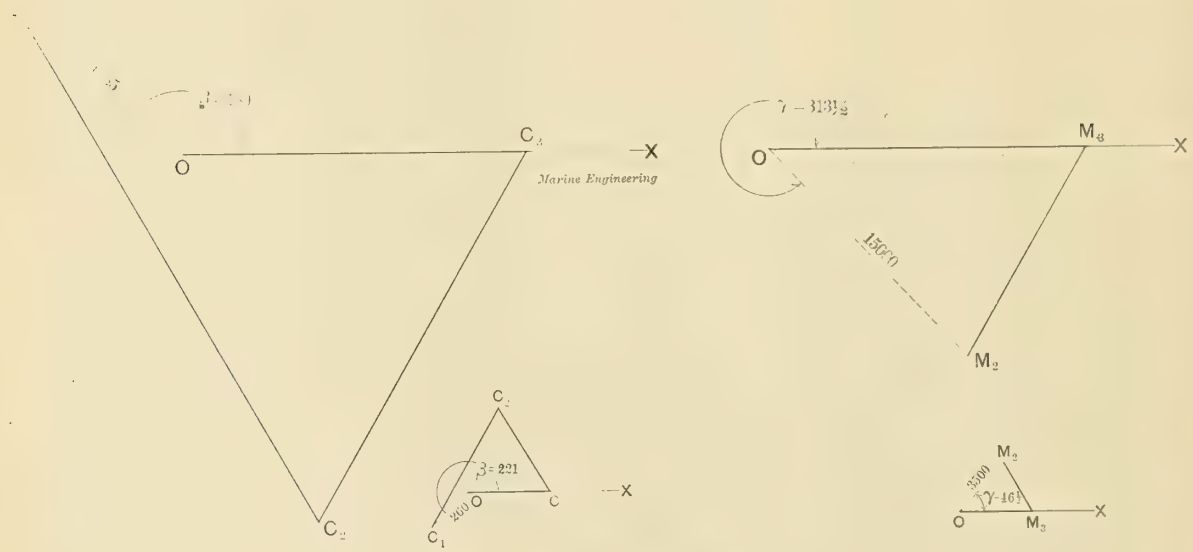


FIG. 4, YORKTOWN POLYGONS.

an engine of given power and revolutions per minute, the more numerous the cylinders the lighter the moving parts of the individual cylinders.

Perhaps this can be better appreciated from examination of Figs. 3, 4, 5 and 6. These give the primary and secondary force and moment polygons for the reciprocating weights of four United States naval vessels. The particulars needed in determining these polygons are given in Table IV., below. The *Charleston* referred to is the first steel cruiser of that name, which was wrecked a year or two since. The polygons of Figs. 3 to 6 are drawn on very different scales for the various vessels. If drawn on the same scale for all four, the differences in actual size would be startling.

After making due allowance for the fact that the engines develop different powers at different revolutions, the ameliorative effect, as regards vibrations, of increase in the number of cylinders is obvious.

RANGE OF DISCUSSION TO BE UNDERTAKEN.

18. I shall proceed now to discuss the question of balancing ordinary vertical inverted engines of 1, 2, 3, 4 and 5 cranks. As a rule, there is one cylinder to each crank, and this is assumed to be the case unless otherwise stated. Main weights only will be considered at first.

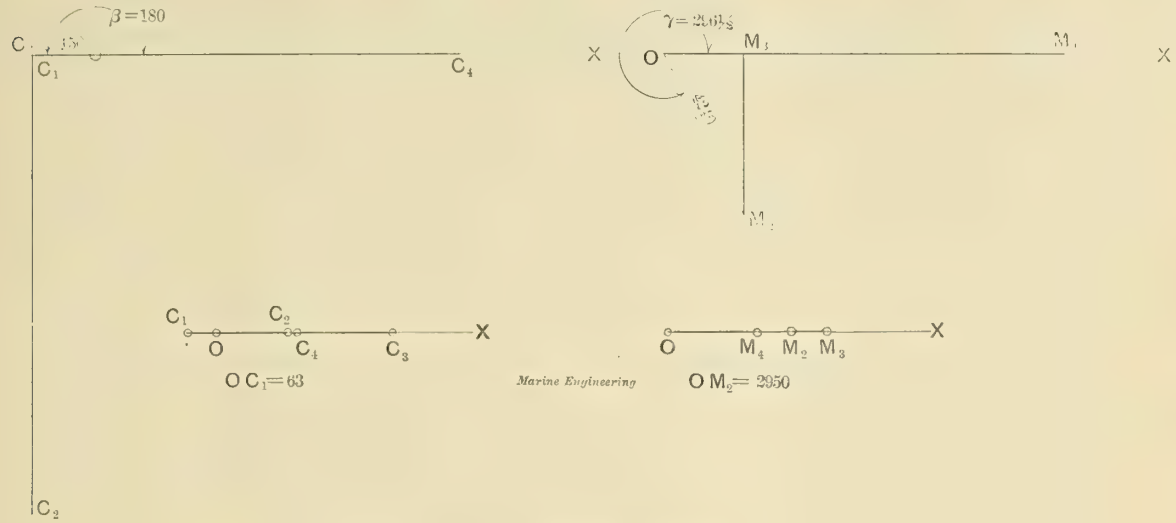


FIG. 5. VESUVIUS POLYGONS.

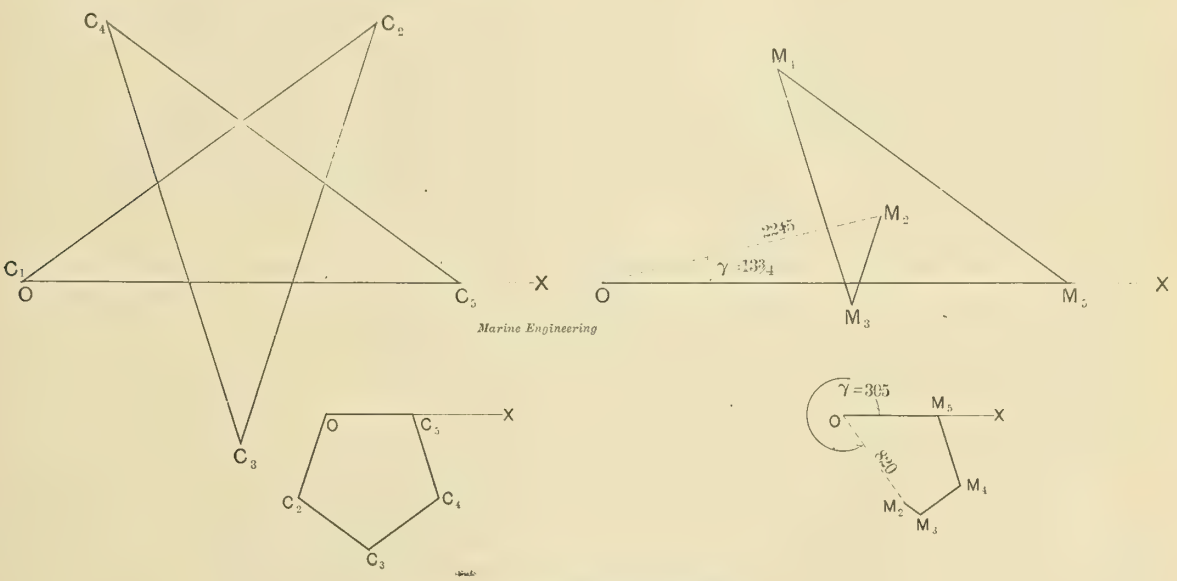


FIG. 6. CUSHING POLYGONS.

ENGINES WITH ONE CRANK.

19. In Appendix A* the resultant forces due to the inertia of moving parts of a single-crank engine are fully determined. With one cylinder there are no unbalanced moments, and partial or complete balance

*Omitted.

cannot be obtained by judicious arrangement of moving parts of several cylinders. It is possible to balance the primary reciprocating forces by introducing large revolving weights, but the strong objections to this course have already been pointed out. It is, however, practicable to balance completely the revolving weights by weights on the shaft opposite the crank pin, and this should always be done. If it is then required to balance the reciprocating weights, the most practicable method is to use lever driven balance weights, one arrangement being shown diagrammatically in Fig. 7. The introduction of such a weight evidently results in an unbalanced couple. If this must be avoided, two weights may be used, as indicated in Fig. 8. It is to be observed that, in the case of a single-cylinder engine with an air pump driven by a lever from the crosshead, the reciprocating air-pump weights partially balance those of the cylinder, and by making them of the proper weight complete balance

FIG. 7, SINGLE CYLINDER BALANCE BY SINGLE RECIPROCATING WEIGHT.

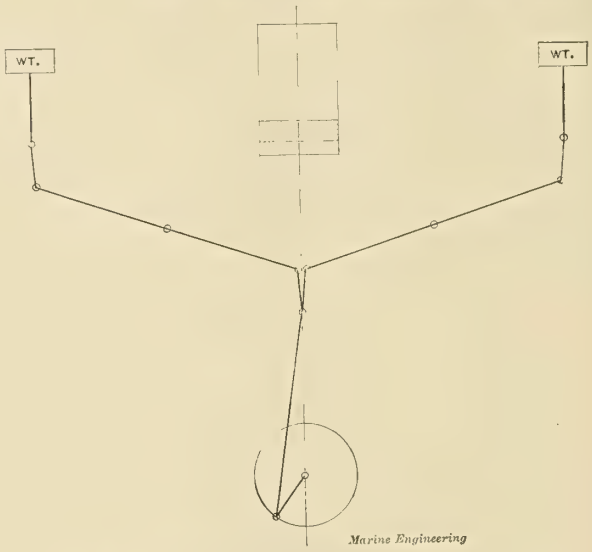


FIG. 8, SINGLE CYLINDER BALANCE BY DOUBLE RECIPROCATING WEIGHT.

may be obtained. But then the air pump weights would be impossibly heavy. The small use now made of single-cylinder engines for marine purposes renders the question of the balance of such engines one of little practical importance.

ENGINES WITH TWO CRANKS.

20. Typical force and moment diagrams for the reciprocating weights of a two-crank engine are found in Fig. 3 for the United States Steamship *Charleston*.

It is entirely impossible to close either force or moment polygons of two crank engines without introducing other sides, i. e., with the two-cylinder engine as usually arranged bob weights must be used to improve the balance. But these must be driven by cranks or their equivalents—eccentrics—resulting in an engine with more than two cranks.

It is probably the best practice, if two-crank engines must be balanced, to secure revolving balance by balance weights opposite each crank, and then for reciprocating balance use lever balance weights for each cylinder, as in the case of a single-cylinder engine. There are special arrangements, however, for two-cylinder engines, which secure perfect balance, though the usual arrangement of two cranks at 90 degrees must then be departed from.

Fig. 9 shows a perfectly balanced two-cylinder arrangement. The cranks are 180 degrees apart, and the cylinders have their axes in line and on opposite sides of the shaft. It is necessary in practice to use a double connecting rod and double crank for one cylinder, these being in each case of the same total weight as the corresponding parts for the other cylinder. Of course, too, the reciprocating parts of each cylinder must be of the same weight. It is obvious on inspection that this engine fulfils the four conditions for balance as regards forces set forth above, since, as the shaft revolves, the center of gravity of the moving weights does not change. Also, since the two cylinders are in line, there are no moments developed. The arrangement of Fig. 9 is not applicable to marine engines. It is used for fan and automobile engines. To

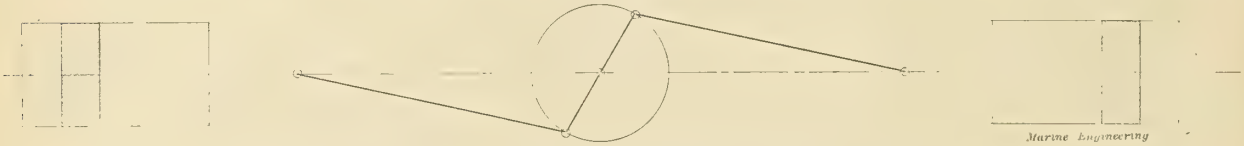


FIG. 9, DOUBLE CYLINDER ARRANGEMENT COMPLETELY BALANCED.

save expense, steam supply complications, etc., the arrangement shown in Fig. 10 is often adopted, even where that of Fig. 9 could be introduced, and it is used for small marine engines where Fig. 9 is not applicable. Fig. 10 is often considered equivalent to Fig. 9, but such is far from being the case. A couple is introduced, since the two cylinder axes are not in the same line, and the arrangement is the worst possible for secondary forces. Consider an engine where the connecting rod is four cranks long, for instances. The

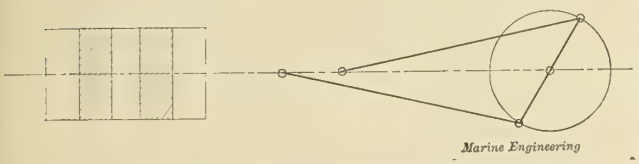


FIG. 10. DOUBLE CYLINDER ARRANGEMENT CRANKS AT 180 DEGREES.

primary reciprocating force is abolished if the moving parts are made of the same weight, but, as the secondary forces are added to one another, we have an unbalanced secondary force equal in amount to that due to half of one reciprocating weight.

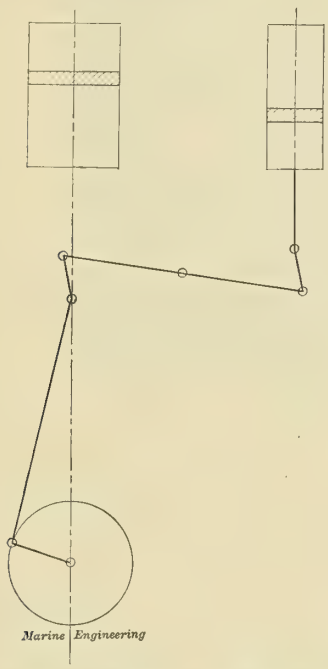


FIG. 11. MAC ALPINE'S BALANCE FOR TWO CYLINDERS.

When we consider revolving forces, the arrangement of Fig. 10 is objectionable only in the introduction of an unbalanced moment. The primary forces are neutralized as for the reciprocating weights, and there are no secondary forces from revolving weights. If the most complete revolving weight balance is wanted, however, the revolving weights for each crank must be separately counterbalanced.

The arrangement of Fig. 10 is a decided improvement, as regards vibrations, over the customary arrangement where the cranks are at 90 degrees. But the latter is preferable from certain practical considerations; for instance, it has no dead center, and gives a much more uniform turning moment.

MAC ALPINE'S TWO-CYLINDER BALANCE.

21. A two-cylinder arrangement has recently been brought forward by MacAlpine, which is superior to that of Fig. 10 in that it eliminates secondary forces. It is shown diagrammatically in Fig. 11. It gives perfect balance as regards reciprocating weights, and its unbalanced couples are athwartships instead of fore and aft, and are not likely to cause objectionable vibration. This arrangement has the practical objections mentioned above to that of Fig. 10, and a few others of its own, due to increase in number of working parts, use of rocking levers, etc. It is, however, a simple and elegant solution of the problem of complete two-cylinder balance, and by doubling it, i. e., using two pairs of cylinders on one shaft, it can be applied to triple and quadruple expansion engines.

ENGINES WITH THREE CRANKS.

22. For three-crank engines the force polygons are three-sided figures and the moment polygons two-sided figures. (See Fig. 4, giving the polygons for the Yorktown three-crank engines.)

We have now reached a sufficient number of cranks to allow reduction of unbalanced forces by properly choosing reciprocating weights and crank angles. Also, in these days of triple expansion, all marine engines of importance have at least three cylinders, so the three-crank case is the first one I have discussed of practical importance.

The moment polygons—two-sided figures—obviously cannot be closed by variation of weight and crank angles. The force polygons are, however, three-sided figures, and as long as any two of the reciprocating weights are together greater than the third, the primary force polygon can be made a closed triangle by adopting proper crank angles. The condition that two weights must be greater than the third allows a wide choice of reciprocating weights and cranks angles, and we should make a choice which will, if possible:—

1. Secure balance of secondary as well as primary forces.

2. Be desirable, or at least not objectionable, as regards the very many considerations other than vibration affecting engine design.

Now if all the reciprocating weights are made equal, and the three cranks set at 120 degrees, we find that—

1. The primary force polygon is a closed equilateral triangle.

2. The secondary force polygon is also a closed equilateral triangle.

3. The crank angles are those fixed upon by common consent as the most desirable from the many considerations other than those of balancing.

If it is desired to secure reciprocating weight balance as regards moments for three-crank engines, the most feasible plan is to introduce reciprocating balance weights at the ends of the engine driven by cranks or eccentrics. Such an arrangement, however, is in the four or five-crank class.

Considering now revolving weights, it is obvious

that if the revolving weight on each crank is equal (cranks being at 120 degrees), forces are completely balanced, while there is left an unbalanced revolving moment, which is, from the nature of the case, smaller than the unbalanced reciprocating moment. For this reason, it is not necessary as a rule to attempt further revolving balance in a three-crank engine with cranks at 120 degrees and equal revolving weights on the cranks, which is, by the way, the usual arrangement, all three cranks and connecting rods being made the same. If complete revolving balance is aimed at however, for moments as well as forces, the most feasible method is to counterbalance separately the revolving weight on each crank. Or the methods of revolving balance described in discussing four-crank engines may be applied.

ENGINES WITH FOUR CRANKS.

25. For a four-crank engine the force polygons are four-sided figures and the moment polygons three-sided figures.

Evidently, then, the "balancing possibilities," so to speak, in the case of a four-crank engine, are decidedly superior to those of engines previously considered. The large and increasing use, of late years, of triple-expansion engines with two low pressure cylinders, and of quadruple expansion engines, has, through the use of four cranks, increased the opportunities for balancing and the development of balanced types of engines.

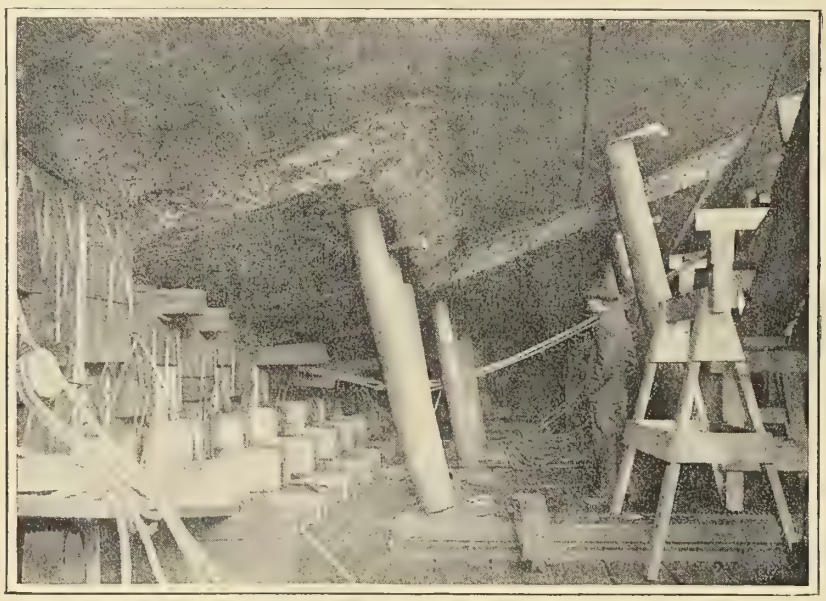
Progress in marine engine balance during the last ten years has been made almost entirely with four-crank engines. It is necessary, then, to consider most thoroughly the balancing possibilities and limitations of such engines.

SPACING OF FOUR CRANKS FOR BEST TURNING MOMENT.

26. Before beginning this task, I desire to call attention to the important fact that the usual spacing of cranks of 90 degrees, found in the case of four-crank engines, is essentially inferior as regards uniformity of turning moment.

If a four-crank engine has four simple, double-acting cylinders, the 90 degree spacing is equivalent, as regards turning moment, to two cranks at 90 degrees. For the turning moment on a crank at 0 degrees in such an engine is the same as that on its opposite crank at 180 degrees, and the two cranks at 90 degrees and 270 degrees are equivalent to one crank with double moment at either 90 degrees or 270 degrees. To secure the most uniform turning moment for double-acting engines, the crank should be at or opposite the angles obtained by dividing 180 degrees, not 360 degrees, by 4, the number of cranks. Thus, starting with the first crank at 0 degrees, the second should be at 45 degrees, or 225 degrees; the third at 90 degrees, or 270 degrees; and the fourth at 135 degrees, or 315 degrees. This conclusion, obvious for four-crank simple engines, is readily shown to apply to quadruple engines, where about the same power is developed in each cylinder. We shall see later that the crank angles for four-crank engines, which it is necessary to adopt for balancing, approximate fairly closely to those most favorable for uniform turning, so that a balanced four-crank engine is also one with a more uniform turning moment than if the 90-degree crank spacing is adopted.

(*To be continued.*)



PATCH ON THE BOTTOM OF THE BATTLESHIP OREGON.

The Accident to the Oregon.

The battleship *Oregon* is at present undergoing very extensive repairs in Puget Sound Navy Yard as a result of striking an uncharted reef on her way from Japan to Taku during the recent Chinese war. For six days she was fast on the rocks and during the rising and falling tides and the thrashing of the sea her bottom was broken into and injured in many places. After being successfully floated off, she was taken to Japan

and drydocked at Nagasaki, where temporary repairs were made which enabled her to remain in service for many months.

The illustration above shows the patch put on by the Japanese workmen over the principal injury where the outside plating was forced up and through the inner bottom, a distance of about 4 feet. The injured hull was covered with a large patch which covered the center line of the vessel and extended over about 700 square feet. The patch was made up by planking the hull in the way of the injury with timbers 14 by 14 inches placed in a fore and aft direction, with a layer of planking 3 by 12 inches placed transversely across the timbers. The planking was caulked and made water-tight, all bolted through and through, and the edges beveled to reduce the friction. Outside of this was fitted a patch of fifteen pound plates, riveted to the hull and caulked, making an independent water-tight patch over the wooden work.

On the inside of the ship, in the way of this injury, the double bottom was filled in with brick and cement work, which was as solid as a rock.

This work of docking and repairing the *Oregon* at Puget Sound is being done under the direct supervision of naval constructor Frank W. Hibbs, U. S. N. The ship was floated into drydock on October 25, 1901. The work of docking her and shoring up the heavy weights of armor and guns, so that the injured portions of the keel and plating might be removed, was one requiring exceptional care. None of the heavy guns or armor was taken off, but the ship was stiffened as much as possible in order that the blocks supporting the keel might be taken out to allow replacing the twisted and torn steel keel and shell plates.

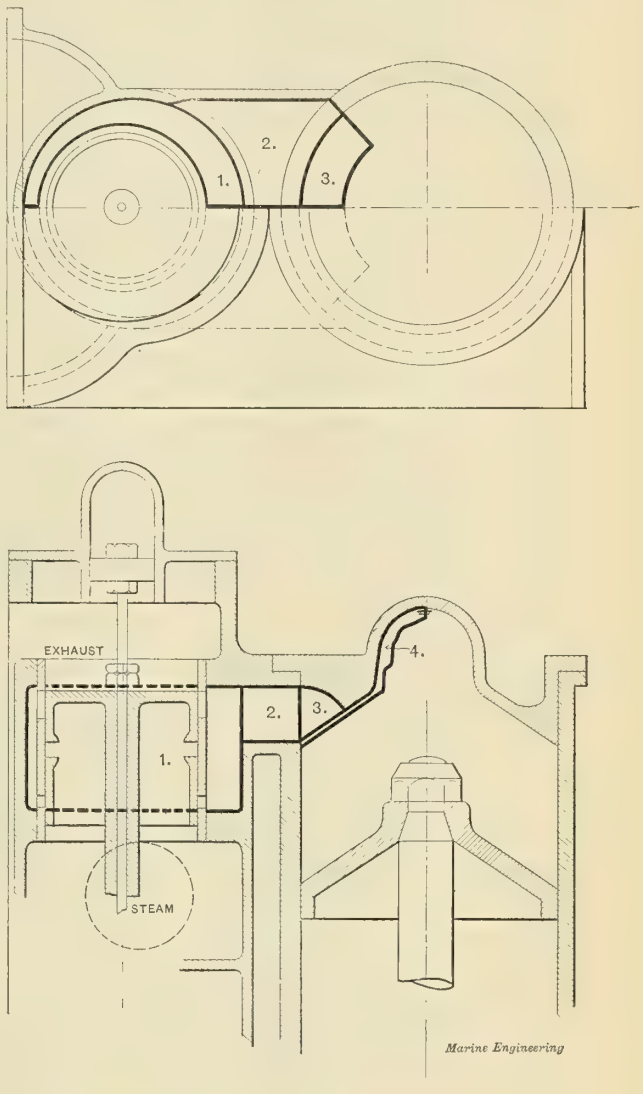
The stiffening was placed in the interior of the vessel in the shape of trusses and shores formed of Oregon pine timbers, 14 by 14 inches, and fitted between the decks and bulkheads in such a manner as to carry the weight outboard as far as possible and thence down to the bottom of the dock by means of cribs and heavy shores, 14 by 14 inches, placed 24 inches apart, and capped by two timbers of the same dimensions running lengthwise around the fore body of the vessel. These timbers were secured to the ship's sides by means of through bolts running through the frames of the vessel, and the top sides of the timber rested on the flange of a 5 by 5 inches angle, also riveted to the hull, below the line of the armor belt. A system of truss work on the inside was fitted on every third frame and with the outside shores formed practically a wall of timber. In this manner the ship was supported while the keel blocks were removed, and, although observations were made daily, no visible sign of sagging of the vessel was noticeable. The cut is reproduced by permission from *Leslie's Weekly*.

Annual Convention of the M. E. B. A. — The annua convention of the Marine Engineers Beneficial Association opened in Washington on Monday, January 20, and lasted nearly through the week. All of the old officers were re-elected for the ensuing year. Many important questions were discussed and the association was reported to be in a more prosperous and satisfactory condition than ever before.

The Calculation of Clearance Volumes.

BY HORACE HOLDEN THAYER, JR.

If the performance of an engine on trial under any given set of conditions is to be ascertained, the amount of clearance, or volume in the cylinder between the piston at either end of its stroke and the steam admission valve should be known. It is sometimes possible to measure this volume by plugging up any openings



ILLUSTRATING METHOD OF CALCULATING CLEARANCE VOLUMES.

which may be in the cylinder and valve chest and filling the cylinder with water or oil. If done in the machine shop the valve openings in particular have to be plugged, and on subtracting from the volume measured the piston displacement and the volume of the piston and piston rod, or volume of the piston, piston rod and tail rod, when the latter is used, we have a measure of the clearance of both ends. If done when the engine is in place on the boat, these deductions do not have to be made, and the clearance at either end may be found independently. In the latter case

the question of leaky valves has to be met, and in either case it is often difficult to enter the clearance space at a level high enough to allow of completely filling it. The only resort from these difficulties is to make a detailed calculation from drawings. This may seem to be a tedious and only roughly approximate method, but it can be used to obtain quickly accurate results.

Suppose a modern high speed triple expansion engine with piston calves has to be dealt with. The figure shows an outline of part of a cylinder and valve chest of such an engine, with the clearance volumes heavily outlined. In this case it is best to divide the volume to be ascertained into four parts, as shown,—(1) the chamber around the valve, (2) the lead to the head of the cylinder, (3) the opening in the cylinder wall, and (4) the space between the cylinder head and the piston when the latter is at the end of the stroke.

With a planiméter the area of (1), shown in the sectional plan, is measured, and the volume thus readily ascertained. Allowances can be made, if desired, for openings in the valve ring, also deductions for any webs, staybolts, etc., which may be in the chamber. Volume (2) is obtained in like manner. To obtain volume (3) the center of gravity of the section shown in the elevation has to be determined. This is best done by outlining it in some way upon stiff cardboard. The plan shows the circumferential length of cylinder wall cut away, and assuming that the section taken travels from one end of the opening to the other, we can measure the length of the arc traveled by its center of gravity. Then the volume is found by use of the theorem of mechanics that the volume of a solid of revolution generated by a plane figure, lying on one side of the axis, is equal to the area of the figure multiplied by the length of the path of its center of gravity.

The same method can be used for volume (4). The inside half-outline of the cylinder is traced and then at a distance from it equal to the linear clearance of the piston, its corresponding half-outline. The area and center of gravity of the space thus outlined are ascertained, and then the volume, the path of the center of gravity being a complete circle. There may be small additions for drain cocks, etc., but these in general will be insignificant, and in any case can be readily computed.

This method of calculating the clearance volume allows of independent calculations for the two ends of the cylinder, may be carried to as high a degree of accuracy as is desired, and with slight change is readily applicable to any desired case.

Bulkhead Doors.— In the express steamer, *Kronprinz Wilhelm*, of the North German Lloyd Steamship Company, the lower parts of the bulkheads are equipped throughout with a system of water tight doors which may be controlled either from the bridge of the ship or from the bulkhead itself. The system was invented by Prof. Dörr, and the company states that it will equip all of its steamships with this system. A demonstration was recently given on board the *Kronprinz Wilhelm*, when all of the twenty doors below the water line were closed from the bridge.

Armored Cruiser King Alfred

The armored cruiser, *King Alfred*, one of four vessels building for His Majesty's navy, was launched from the Naval Construction Works of Messrs. Vickers Sons and Maxim, Limited, on October 28, and the accompanying illustrations show the ship on the ways as she was water-borne after the launching. At the time of the launching, the *King Alfred* had in place all of her side armor, the 2-inch nickel steel, the after barbette and the main deck casemates. Her launching weight was about 8,070 tons, but as the ways were of the unusual width of 6 feet 6 inches the pressure per square foot was reduced to 1,723 tons. The time taken by the ship from the first movement until she was floated was 59 seconds, and by means of the chain drags, which are shown in the illustration, and which weigh 400 tons, the hull was brought to rest 70 feet from the end of the ways.

These new ships resemble in many respects the *Powerful* and *Terrible*, but are great improvements over those cruisers. The general dimensions of the *King Alfred* are: Length, 500 feet; beam, 71 feet; load displacement, 14,100 tons; corresponding draft, 26 feet. The vessel carries 2,500 tons of coal, which will give her a steaming radius of 12,500 miles at 14 knots. A water line belt of armor with maximum thickness of 6 inches amidship and 4 inches at ends, and 11 feet 6 inches deep, extends along the sides of the ship and beside the machinery, boilers and magazines. At the after end of this belt a 5-inch armored bulkhead is fitted and 2-inch nickel steel protected plating is worked in on the bows, and aft of the screen bulkhead is a protective deck 2 1-2 inches thick, giving protection to the steering gear and after capstan. Within the citadel two protective decks are worked, the upper being 2 1-2 inches and the lower one 1 1-2 inches thick. The 9.2-inch guns are protected by two 6-inch barbettes, one forward and one aft, in addition to the gun shields, and the 6-inch guns have separate 5-inch armored casemates The conning tower is of 12-inch armor.

The main battery consists of two 9.2-inch Vicker's guns, giving a rate of firing of four aimed rounds per minute with a 380 pound shot, developing a muzzle energy of 17,830 foot-tons. There are also twelve 6-inch guns mounted in a series of two-storied casemates, four on either broadside, and so arranged that four can be fired directly ahead and four directly astern. There are also a large number of 12-pounder and machine guns. The total number of projectiles of the main and secondary batteries that can be fired ahead or astern is 116 per minute, with an aggregate weight of 5,720 pounds, while the broadside fire totals 11,190 pounds.

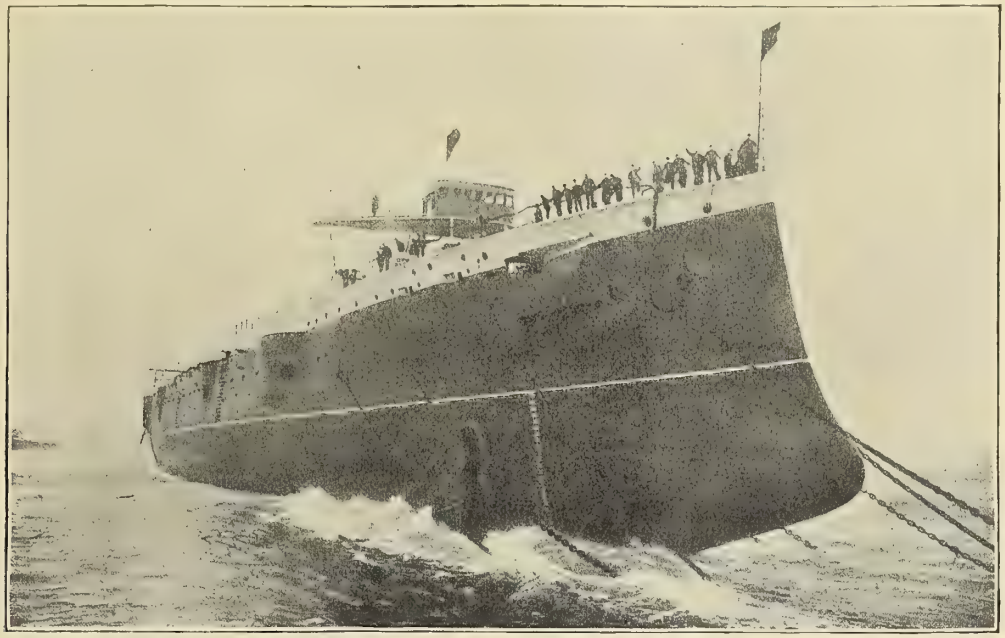
There are two sets of four cylinder triple expansion engines, each set developing 15,000 horse power. The diameter of the high pressure cylinder is 43 1-2 inches, that of the intermediate 71 inches, and that of the low pressure cylinders is 81 1-2 inches, all having a common stroke of 48 inches. There is one piston valve on the high pressure cylinder, two on each intermediate pressure cylinder, and double ported slide valves on the low pressure cylinders. All cylinders are steam jacketed. There are two gun metal con-

densers bolted to the back columns of each engine, and the collective cooling surface of the four is 32,000 square feet.

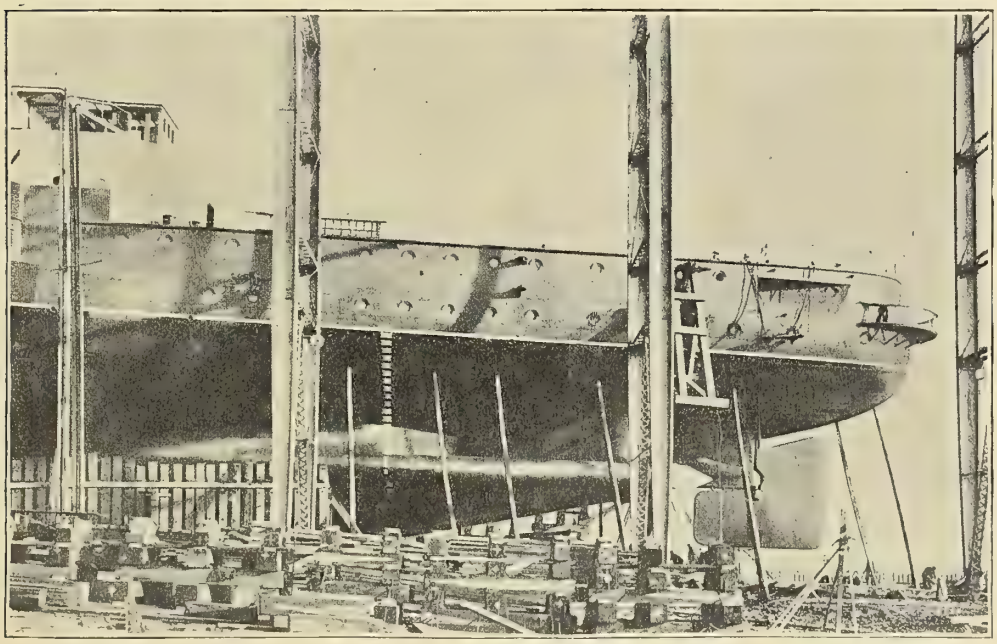
The air pumps are direct connected by levers to the main engines. Steam is supplied at a working pressure of 300 pounds by 43 water tube boilers of the Belleville economizer type, placed in four separate compartments. This enormous power is expected to drive the ship at a speed of 23 knots.

For the above facts and photographs we are indebted to *Engineering*.

Wireless Telegraphy. — Sig. Marconi has demonstrated the possibilities of wireless telegraphy by transmitting from Cornwall, England and receiving at St. Johns, Newfoundland, a distance of over 2,000 miles, repeated signals of the letter S. This work has been simply in the nature of an experiment, and upon the perfecting of the apparatus Marconi expects to transmit and repeat messages. The fact that wireless telegraphy can be operated from such great distances indicates either that the sea forms no barrier to the induction waves, or that they travel along the surface.



LAUNCH OF THE ARMORED CRUISER KING ALFRED.



STERN OF THE ARMORED CRUISER KING ALFRED SHOWING LAUNCHING CRADLE.

TOW BARGES AS GENERAL FREIGHT CARRIERS.

EDWIN B. SADTLER.

The history of barges such as are towed is very similar to that of canals, which are well known to have existed in the time of the early Egyptians and Chinese, for hundreds, if not thousands of years before the Christian era. Notwithstanding the great number of years that barges have been used, their greatest usefulness has only been developed in very recent years; in fact their era of expansion and development has just fairly begun.

While some very large barges have been used in European countries (the writer has seen barges over two hundred feet long and forty feet wide, in use on Russian canals) their use has not been as common as in the United States, where they have been used on rivers, canals and lakes as well as for sea towing. The sea towing is what we now propose to consider.

While this custom has been practised for some years, it was made possible and safe to carry it out on a large scale by the invention of the towing machine by Mr. T. Jackson Shaw, in 1888. This machine was patented by Mr. Shaw and Mr. John Spiegle, then superintendent of the Boston and Philadelphia Steamship Company, and first applied to the Boston Tow Boat Company's collier *Orion*, which, strangely enough, has been chosen to perform one of the most difficult feats of towing—that of taking the mammoth new floating dock for the United States Government from Sparrows Point, Md., to Algiers, La. This trip was successfully made in eighteen days, ending November 3, 1901, this enormous box-like craft having been towed nearly two thousand miles. One of the best examples of sea-towing is the Reading Railroad Company's large fleet, trading between Philadelphia and eastern ports. In this service a tug boat, or rather towing steamer of one hundred and seventy feet in length, with engines of about one thousand horse power, tows three, and at times four barges, of sixteen hundred tons capacity each, a distance of five hundred miles, and returns with empty barges in six and one-half days, maintaining a schedule that can be relied on except in extremely severe weather. The same company is now building barges of three thousand tons capacity and expect to tow two of these with one tug of the above size.

Barges of like capacity are now in use between Cuba and Philadelphia or Norfolk, and two additional barges of four thousand tons capacity each have just been ordered for this service. On the Great Lakes barges are now in use of from five to six thousand tons capacity each.

In these days of low freights, some improved methods must be used to make the transportation of coarse and non-perishable freights pay, and it is the belief of the writer that if long distance towing were properly developed it would result in large profits to those investing in this type of transportation. The economy of the system arises largely from the fact that the power being applied from a comparatively small vessel, a small crew is required, being seventeen men on the tugs referred to above. The barges having no machinery except pumps and small auxiliaries, require an extremely small crew, being usually five men to each barge. The greatest economy comes from keeping the tugs constantly employed, by having a sufficient number of tugs and barges, so that every time a tug comes to the end of the voyage she leaves her barges to be unloaded, and takes up a fresh tow already loaded and waiting for transportation.

The special types of both tugs and barges would, to a certain extent, have to be designed to meet the requirements of the particular service for which they were intended.

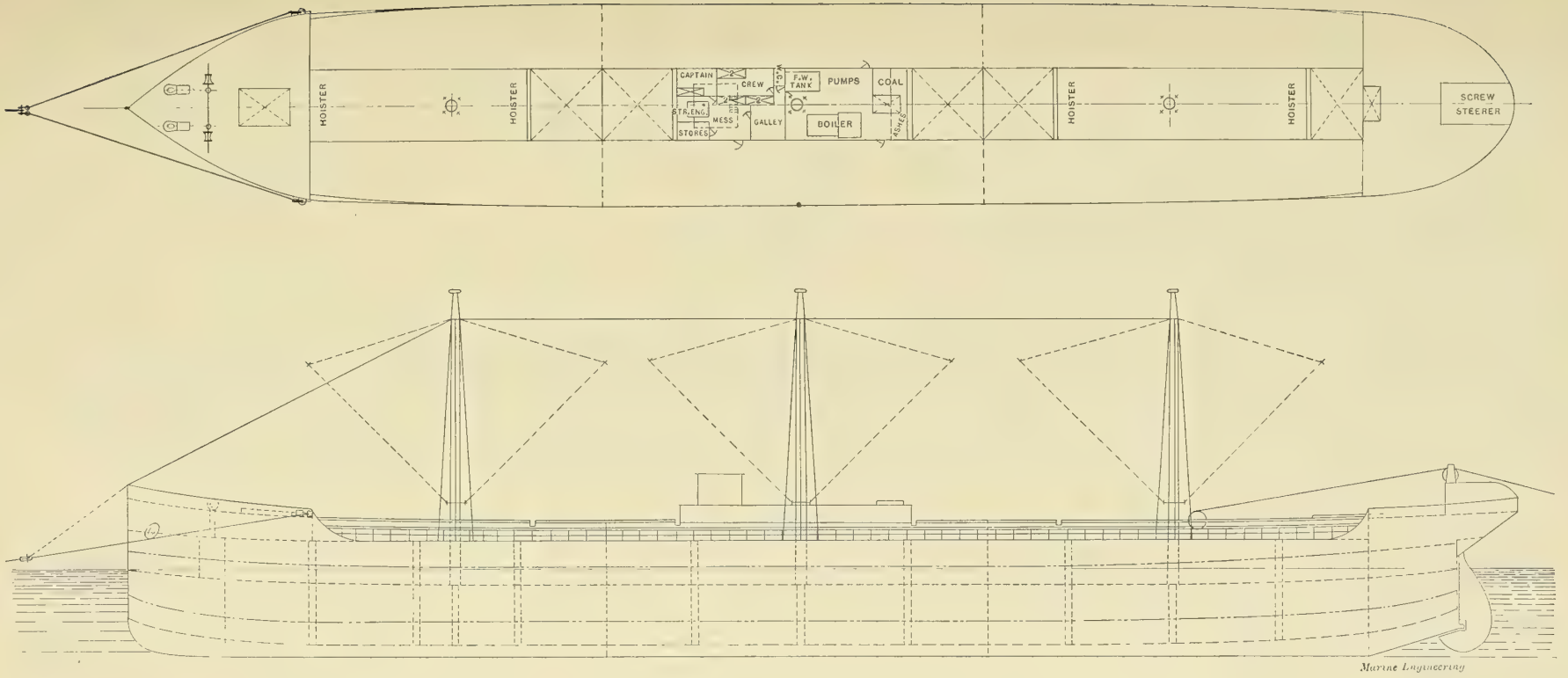
Being a firm believer in the possibilities of long distance towing I have prepared a sketch of a barge suitable for handling freight of a miscellaneous character, such as is handled by the Atlantic liners and coastwise trade. The principal characteristics of this vessel are as follows: The barge to be 300 feet long on the water line, 46-feet beam and 26-feet molded depth, having a trunk extending from forecastle to poop deck, forming the hatches, and between the hatches a cover for the hoisting engines. This trunk would be raised as shown between the third and fourth hatches, forming a house which would contain the crew's quarters and donkey boiler, pumps and steering engine. There would be a pilot house directly over this house. The three masts form derricks for the six hatches, the main mast also forming a stack for the donkey boiler. Simplicity of construction and few obstructions for the sea to strike would be the main features of this barge. As the crew would live amidships the space under the forecastle could be used for windlass engine, paint lockers, etc. The poop could be used for stores or freight, as desired. As barges are frequently difficult to steer the stern has been cut away and a balanced rudder of large size fitted. Both peaks would form ballast or trimming tanks.

In order to assist in keeping these barges on their course they are designed to be towed from a towing machine on the tug or barge ahead, the end of the hawser being shackled to a bridle attached to the sides of the vessel about forty feet from the stem, as shown on the sketch. This would have a tendency at all times to keep the barge straight in the wake of the tug. When two barges are in tow the hawser to the second would lead through a swivel chock on the stern of the first barge, which makes the hawser lead properly without serious side chafing when changing the course of the tow. These barges would each have a deadweight capacity of five thousand tons on twenty feet draft of water.

A tug or steamer 200 feet by 36 feet by 20 feet, closed in forward to the upper deck and having engines of about 1,700 horse power would tow two of these barges 3,200 miles in twenty and one-half days.

Taking into consideration interest on first cost of vessel, insurance, maintenance cost of crew, coal consumed, and in fact, all expenses entering into the use of vessels, it is found that the expense of the tug mentioned above would be about one hundred and fifty dollars per day, and the barges each about fifty dollars per day.

This outfit, to work at its most economical point, would, by allowing the tug to start on the return trip



TOW BARGE FOR OCEAN FREIGHT SERVICE.

after one-half day in port, taking up a tow already prepared, make a round trip in forty-two days.

The barges would be allowed nine days in port for unloading and reloading, when they would be taken in tow by a second tug, due at that time, which tug would leave her barges to be taken by the next tug and so on.

Working out this schedule completely it is found that for a trip of this length it would require three tugs and ten barges, which would have a capacity of transporting 900,000 tons per annum a distance of 3,200 miles, at a cost of 26 cents per ton.

As the prices for full cargoes of the cheapest class of freight, as shown by ships' charters reported in the daily papers, seldom run below two dollars per ton for this distance, it can readily be seen how very profitable this business would be. Should the service be such as to permit of larger units, a single barge could be used instead of two, which would still further reduce expenses of transportation.

The greatest objection to barge towing has been the reluctance of insurance companies to take the risks. This should and will be overcome in time, as experience has shown that it is possible to tow these barges past such places as Hatteras, and also that of the large number of barges lost each year, the majority of them are old, worn-out hulks, not fit to go to sea except under favorable circumstances. It is also notable that few, if any, barges specially designed for this service have ever been lost when towing behind a vessel equipped with a towing machine.

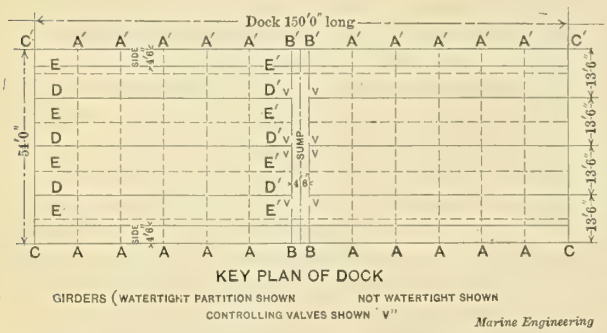
Wireless Telegraphy.—It is stated that the Channel fleet of Belgian mail boats will be equipped with wireless telegraphy installations. Experiences with this system have been carried on for many months by the company operating this fleet.

Floating Dock for Khartoum.

A floating dock has been designed for the Egyptian War Office for service in Khartoum, and from a complete description, with illustrations, which appeared in the London *Engineer*, we quote as follows:

Electricity is to be adopted for operating the pumping plant, and it was considered desirable that the boilers and generating plant should be on shore. The designs were required complete in every detail, so that with material supplied from England the dock could be constructed and erected by native labor at the site on the Nile.

Referring to the illustrations it will be seen that the lower portion of the dock consists of a pontoon 150 feet long by 54 feet wide, the depth varying from 3 feet 7 1-2 inches to 2 feet 10 1-2 inches. The two pontoons, forming the sides of the dock, are 150 feet long by 9 feet deep by 4 feet 6 inches wide. The dock bottom is divided into halves by a transverse sump 4 feet 6 inches wide. Each half is subdivided into four water tight compartments by longitudinal divisions. Each compartment discharges into, and is filled from the sump by means of a flap valve operated through a shaft and levers by the man in charge of the dock.



The sump is flooded by a 10-inch diameter sluice valve, and pumped dry by two 6-inch electrically driven centrifugal pumps arranged in duplicate, one on each side of the dock.

Each of the pontoons forming the sides of the dock is divided into twelve water tight compartments by vertical diaphragms, and there is sufficient buoyancy in the sides to support the dock, should the whole of the bottom compartment be completely filled.

The weights are as follows: Steamer, 200 tons; dock, 295 tons; machinery, 10 tons; timber packings, 37 tons; total, 542 tons. The draft of the dock is: (1) Unloaded, 1 foot 9 1-4 inches; (2) loaded, 2 feet 8 1-2 inches; (3) when passing under a steamer of 3 feet 6 inches draft, allowing 6 1-2 inches clearance, 9 feet 10 inches. Now, when passing under a steamer with a draft of 9 feet 10 inches, the weight of water displaced by the dock is 976 tons. The weight of the dock and machinery and the effective weight of the timber packings is 328 tons; hence the weight of the contained water is 976 — 328 = 648 tons. The quantity of water to be pumped is thus 648 tons. The holding capacity of the lower portion of the dock is 699 tons.

The sides of the dock are relied on to give longitudinal stiffness, and to them the weight of the ship, not directly water borne, is transferred by ten plate cross girders, two sump plate and two end girders. These cross girders are continuous, and the angles of the water tight partitions and other longitudinal girders are stopped off where they intersect. The cross girders are not water tight partitions, draining openings being provided. In each half of the bottom of the dock the water tight partitions form three longitudinal girders, and there are four other plate longitudinal girders not water tight partitions, but provided with drainage openings. To support the ship a teak bearer 10 inches wide and from 4 inches to 7 inches thick to allow for the camber of the deck is secured to the top of each longitudinal girder. On these, packing blocks, 10 inch by 10 inch by 2 feet long, are laid at intervals of about 6 feet to support 8 inch by 8 inch transverse bearers. The transverse bearers carry the 9 inch by 4 inch planks laid continuously, which support the flat bottom of the vessel.

To calculate the sectional areas of the dock sides, the vessel load of 200 tons was assumed to be evenly distributed over the middle hundred feet. This gives a bending moment of 625 foot tons, and a shear of 12 1-2 tons per side. If, however, the pontoons at one end of the dock are supposed flooded, others remaining empty, a maximum bending moment would occur about 16 feet to the right of the center line, and equal to 1,000 foot tons per side. The maximum shear would be 30.5 tons per side.

When designing the cross girders, the loading with the vessel was assumed as above, and the load on a cross girder was taken as uniformly distributed over the middle 27 feet. Greater bending moment arises, however, if the dock is supposed unloaded, and the outside pontoons completely flooded, the central pontoons being empty. This gives a maximum bending moment at the center of the cross girder of 124 foot tons. Taking the maximum draught of the dock at 10 feet, this head of water gives a pressure of 4.45 pounds per square inch on the under side of the dock. The stiffeners are 2 feet 1-4 inch pitch, and formed of 4 inch by 3 inch by 5-16 inch Z irons, as shown. Each stiffener serves an area of approximately 5 feet 10 inches by 2 feet 1-4 inch hence the total load it supports is:

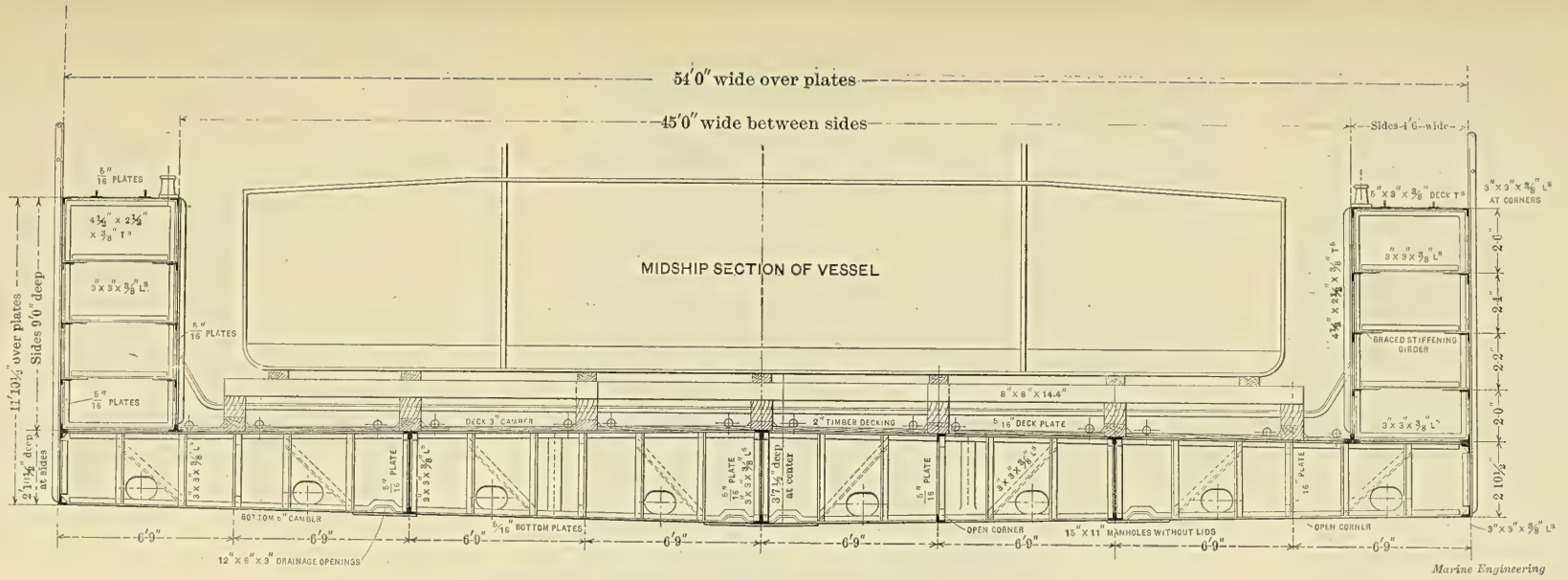
$$\frac{70 \times 24\frac{1}{4} \times 4.45}{2240} = 3.37 \text{ tons.}$$

The maximum bending moment is

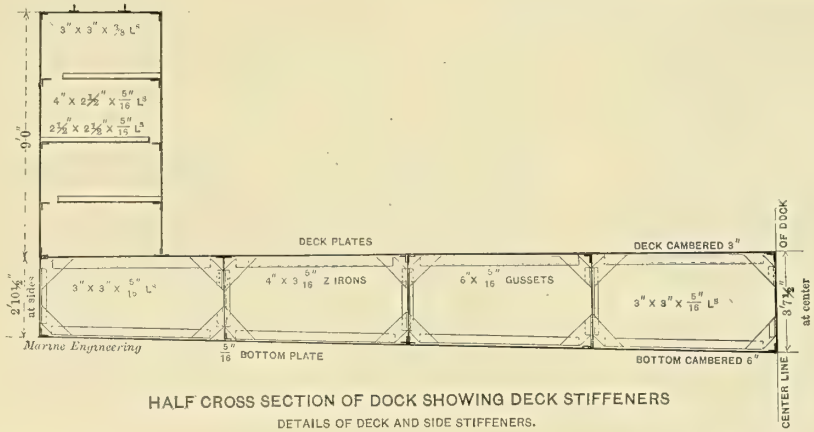
$$\frac{3.37 \times 70}{8} = 29.50 \text{ inch-tons}$$

Assuming that a strip of the bottom plate 10 inches wide acts as a flange to the Z iron, it will be found that the moment of inertia of the small compound girder is 14.37 inch-units, and the maximum stress on the Z bar equals 6.4 tons per square inch.

To stiffen the sides of the dock against buckling, due to the shearing force, and against the water pressure when submerged, three horizontal braced stiffening girders are arranged. The side plating is thus divided into four bays. When the dock is passing under a vessel, the head of water above the center of the lowest bay is 5 feet 6 inches, giving a pressure of 2.4 pounds per square inch on the plating. Considering a vertical strip of the plating in the lowest bay as a

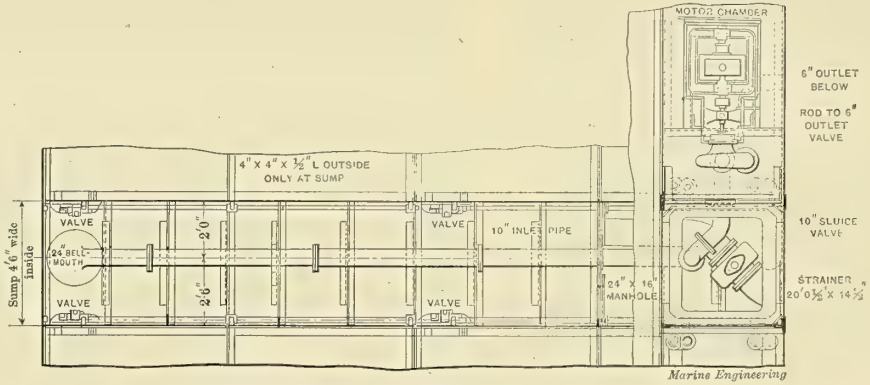


CROSS SECTION OF DOCK SHOWING CROSS GIRDER.



HALF CROSS SECTION OF DOCK SHOWING DECK STIFFENERS

DETAILS OF DECK AND SIDE STIFFENERS.



HALF PLAN OF SUMP ALSO SHOWING MOTOR CHAMBER.

SECTION AND PLAN VIEWS OF FLOATING DOCK FOR KHARTOUM.

bearer 24 inches span, fixed at the ends and uniformly loaded with 2.4 pounds per quare inch, the maximum stress due to bending is 30.5 tons per square inch.

The maximum shear on each side pontoon, as previously mentioned, is 30.5 tons. The maximum stress calculated by Gordon's formula on a column 24 feet 2 inches long, due to a shearing force of 30.5 tons per side, is 2.2 tons per square inch. The above stresses, however, do not occur together. The main 4 inch by 2 1-2 inch by 5-16 inch angles of the horizontal stiffening girders have an unsupported span of

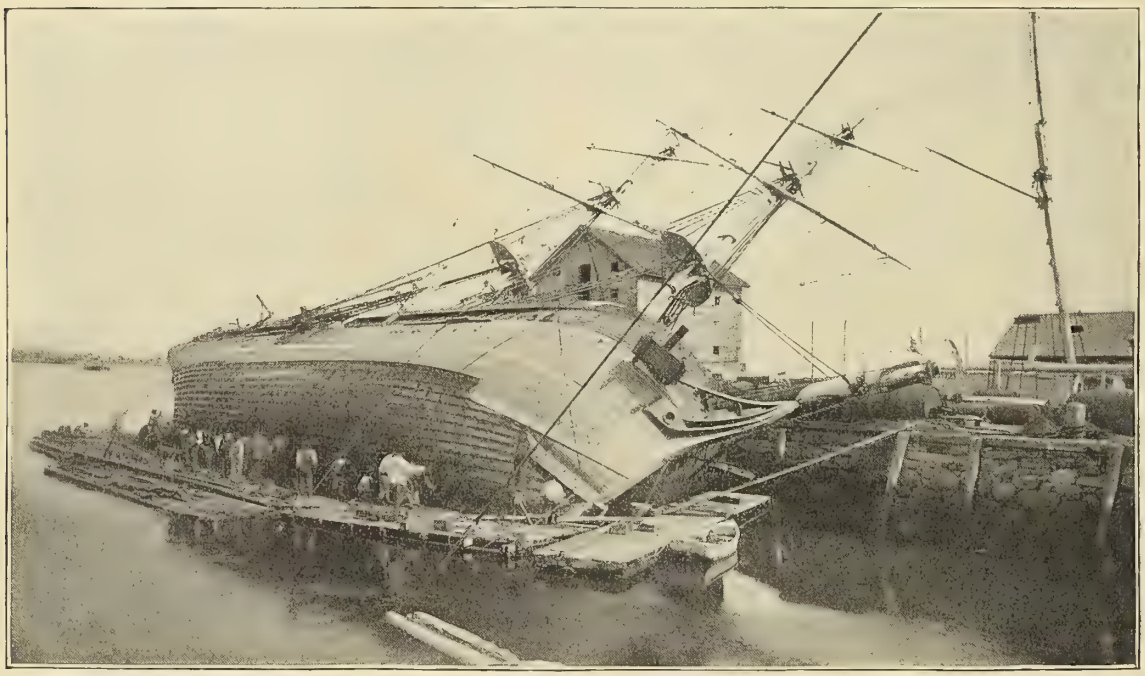
6 feet and 3-4 inch. Taking a span as a beam fixed at the ends, it is found that the water pressure supported by it is 1.59 ton, producing a bending moment of 9.6 inch tons. Assuming that a strip of the plating 9 inches wide acts as a flange to the angle iron, the maximum stress works out to 6.1 tons per square inch.

The deck plating is generally 4 feet 3 1-2 inches wide by 5-16 inch thick, and in lengths of from 15 feet to 19 feet.

In each of the dock sides, near the center, a water tight chamber is formed to contain the motor and pump. The sump is closed at each end by a water tight diaphragm. The diaphragm at one end has a hole 10 inches diameter for water inlet, connection to the side of the dock being made by the 10-inch pipe, sluice valve and strainer. Each compartment is filled or emptied from the sump by a flap valve of 30 square inches area. A deadweight on the lever holds the valve shut, a pin being provided to hold it wide open. The cross girders in each compartment have suitable apertures and manholes, and the stiffeners on the dock bottom are stopped off so that the water may drain away freely. The suction pipe to each pump is 6 inches diameter throughout, and a water tight joint is made where it passes the sump diaphragm and the plating of the motor chamber. The delivery pipe is also 6 inches diameter, and also passes the motor chamber plating by a water tight joint. A 6-inch sluice valve is provided to shut off the discharge when the pump is not in use. A 2-inch air pipe with stop valve is provided, to allow the air to escape from the sump when it is being flooded from outside.

The water tight compartments have each a 3-inch air pipe arranged at the ends of the dock and carried well above the highest water level. They communicate with the top of the pontoons, which may thus be completely filled.

A house is provided on the top of one side of the dock, to contain the valve operating levers, hand wheels for sluice valves, switchboard, etc. Eight cast iron bollards are fixed to the top of the dock sides in convenient positions. A foot bridge is provided at one end of the dock. When not in use each half of the bridge is folded against and secured to the side of the dock. The deck is covered with teak decking 2 inches thick, laid transversely, and secured in position by 2-inch square retaining strips spiked to the flooring, and to the longitudinal teak bearers previously mentioned.



SHEATHING AND COPPERING A WHALESHIP AT NEW BEDFORD.

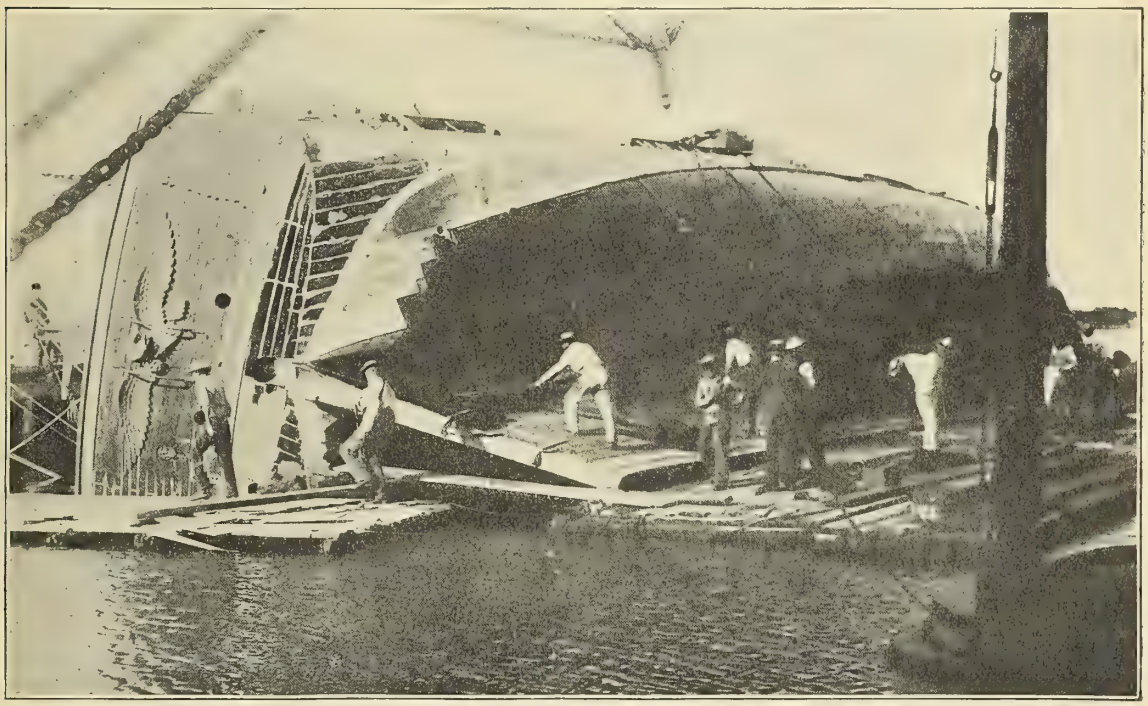
How Whaleships Were Sheathed and Coppered.

The great increase in recent years in the size of vessels has naturally called for a corresponding increase in the sizes and capacities of marine railways and of dry docks, both graving and floating. In this connection it is very interesting to recall the manner in which vessels were frequently repaired.

Among the most staunch vessels that have ever been built for the American merchant marine were the whale ships which sailed from New Bedford and other New England ports. These ships were usually built of live oak, and very staunch, so that they could withstand the punching and the squeezing of ice floes in the Arctic ocean. Before a vessel sailed it was the custom to put her in as thorough condition as possible for a voyage of from three to five years, and, instead of hauling her out on a marine railway, the vessel was usually sheathed and coppered as shown in the accompanying illustration.

A tackle was hooked on to the mainmast and the

vessel was hove down as depicted. Even if more or less water were to get into the cabins and between decks it was easily pumped out. It was not difficult at all to copper the keel on one side, the men working from floats, and the whole side of the ship would be sheathed and coppered while the ship was hove down in the manner shown. She would then be hauled out into the stream, turned round, and the other side sheathed and coppered in the same way. The great strength of these old ships is well demonstrated by the ease with which they withstood the strain of this operation. The accompanying illustration shows a whale ship being repaired alongside the wharf in New Bedford some fifteen years ago.



COPPERING THE BARK SUNBEAM.

Only recently the bark *Sunbeam* was coppered in this same manner. The accompanying picture taken of this bark shows that the hull is first thoroughly caulked and is painted before being coppered. This picture shows the use of floats from which the carpenters and other workmen carry on operations. It also gives an idea of the peculiar shape of the hull of these old whale ships, which are very round and large at the bilge, and which have square sterns, oftentimes with elaborate stern pieces, as this one has. The bark *Sunbeam* is now on a whaling voyage, and was recently reported with a very large catch of sperm oil.

Advertising Classification. — In order that our advertising pages may be more convenient for reference we shall hereafter classify the advertisements more thoroughly. At the top of each advertising page will be found a classification heading indicating the kind of advertisements on that page.

PROPELLER SHAFTS AND NEW FORM OF STERN TUBE.

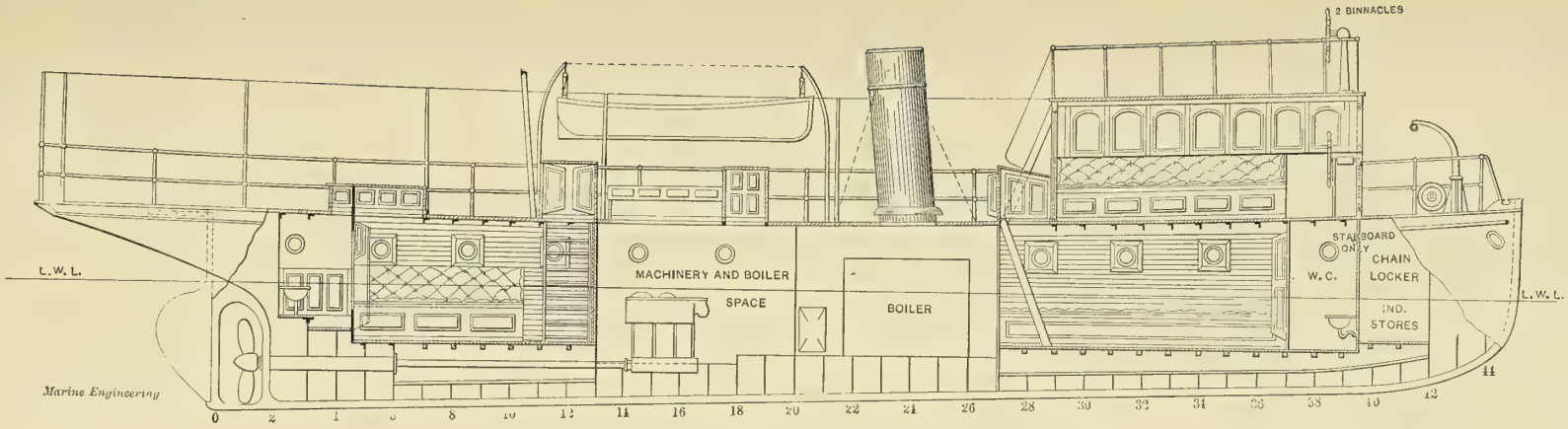
At a recent meeting of the Institute of Marine Engineers Mr. John Corry delivered his presidential address in which he discussed very completely the subject of tail shafts and stern tube bearings. After describing the plans which he had adopted for overcoming certain troubles experienced with the usual flat bottom condensers, Mr. Corry dealt at some length with the subjects of boilers, liquid fuel and turbine propulsion. We make the following extract from his address:—

I have left one of the most important details to the last. It is one that has been very much discussed of late and on which a great deal can be said. I mean the construction and fitting of the tail-end shaft. As a rule the tail-end shaft is fitted into a long cast-iron stern tube. The end next the propeller is fitted with a brass or gun-metal sleeve to work in the lignum vitae bearing, and a shorter sleeve at a distance of several feet is shrunk on, which works in the inner stuffing box. This leaves several feet of bare shaft between the sleeves running in salt water, and exposed to corrosion and galvanic action from the ends of the liners. This I do not consider is a very satisfactory arrangement. But as the bulk of existing steamers are fitted in this manner it may be worth while considering what is the simplest and best method of adding to the life of the shaft without altering the whole construction. The grooving and nicking that goes on at the end of the liners is the principal cause of the shafts breaking and being condemned. The grooving is a combination of three causes—corrosion, galvanic action and the bending of the shaft. There has been a considerable amount of discussion as to the proportion

in which these causes acted, but that they all do act is, I think, undoubted. The bending is, of course, caused by the shaft getting out of line, and working eccentric by the wearing down of the lignum vitae bearing. This would be bad enough in a shaft running on shore, but it is ten times worse in a ship plunging about in a sea-way. Why the shaft bends at the ends of the liners, and not as a whole, is caused by the local weakness at these parts, the sleeves acting as stiffeners, and as the sleeves have seldom been tapered sufficiently off at the ends, the action is strongly localized. The obvious remedy is to cover the whole of the shaft with a long sleeve of gun metal, so as to protect the whole of the surface and to maintain its strength unbroken. This sounds fairly simple, but to carry it out practically is very difficult, especially on the smaller shafts. I believe, however, that there would be no real difficulty if the operation was carried out in a dry well or pit.

The shaft should be slightly stepped, and, of course, the liner, so that that lowest section would slip over the shaft. The heating and all the operations should be carried out vertically; the heating by jets of gas, and the cooling by jets of water. If any large shaft maker would fit up such an apparatus and supply shafts properly covered he would find that it would pay, although I suppose that the present system of broken shafts pays their makers best. However, to cover the shaft as a whole is an operation very few of our engineers care to tackle, preferring to cover it in two, or even three, lengths and burning the joints together. This also is an operation requiring a great deal of care, and may not be quite a success, although it may appear so at the time. The burned ends may, by-and-by, show a very fine shrinkage line, which is quite sufficient to admit the salt water, and when tested by cutting into shows the shaft with a very fine nick carried well down into it. I had a shaft about two years ago which required to be renewed, and as the stern tube was of the ordinary construction if I wished to protect the whole of the shaft I had either to cover it in three pieces and burn the joints together or to cover it with three distinct liners. I preferred the latter, and tapered the ends off with a long taper, and grooved the tapers with a series of rather deep grooves. I then lapped the tapered ends very carefully with thin rubber tape and solution and a series of whipcord roundings. Although the exposed parts of the shaft did not exceed 1-4 inch when we opened out a few weeks ago we found it in perfect condition, and though the bearing was not down more than 1-8 inch I had it relined with lignum vitae. I think if Lloyd's would make a rule that at every two years, when the shaft is withdrawn for examination, the lining should also be renewed, they would be conferring a real benefit on the shipowners. As an alternative, when the whole of the shaft was efficiently protected from corrosive action to the satisfaction of the surveyor, a triennial inspection by drawing in the shaft might be deemed sufficient, if the bearing was at the same time renewed. I believe such a rule would meet the approval of the Committee of Lloyd's Register. The shaft should in the first place be of ample size for its work. I consider that Lloyd's old rules, though much heavier than the Board of Trade rules, erred on the side of allowing smaller shafts to be fitted than is now felt to be prudent, considering the wear and tear and rough handling which steamers in ballast are exposed to. But all this has been very carefully gone into, and the present amended rules now require much heavier shafting. If shafts are built to the present Lloyd's requirements, of good material, and fairly used, we will not have so many mishaps to shafts as has been the case of late. The shaft of the *Star of Australia*, although built before the present rules were in force, is fully up to present requirements as to size. Next to size, and even more important, is material. The material we adopted is nickel steel, which is supposed, and I think with justice, to be both stronger and tougher than either wrought iron or ordinary steel. It is at any rate much dearer. I think, however, if a heavy shaft is made of bar iron, scrapped, of a good fibrous and tough quality, soundly put together, it should make a reliable shaft. What is called scrap iron may be, and generally is, a mixture of scrap iron and scrap steel, and for a tail shaft I think this is not good enough.

In the last two steamers we built we introduced a novel arrangement of stern tube and stern shaft. The stern tube of the *Star of Australia* is comparatively short, being about nine feet over all, and is made of gun metal throughout. It is in two separate halves closely bolted together, on a plan first proposed by Mr. Hector M'Coll, but the details of construction and fitting are my own. The advantage of the stern tube being in two longitudinal halves is that by taking off the nut at stern post the tube can be drawn into the bulkhead and opened out without withdrawing the shaft, merely keeping it carefully suspended in the center of the opening. The two halves are exact counterparts, and there is 8 feet of bored out lignum vitae bearing, in two 4 feet lengths. There is also about one foot of packing, and, about 18 inches from the packing, there is a heavy capped white metal bearing on a strong pedestal about two feet long. With the comparatively short stern tube there is no difficulty in fitting the liner in one piece, and therefore there is no risk or trouble from corrosion. The length of bearing is in all about double what could in the ordinary way be fitted, and even if the bearing wears down a little (and you can readily understand that this is a very slow process) by slacking the nut on boss of stern frame the tube can be turned half round, thus renewing half of the bearing. If you could make sure of excluding sand and dirt from the stern tube the wear would be scarcely appreciable; but to make it complete according to my ideas, an arrangement should be fitted to exclude all sand or dirt so that the bearing could be run altogether in oil. I designed a special gland or packing ring, and an oil pump or feeder, to keep the tube full of oil, not trusting to oil being dropped through a pipe from the deck but forcing it up through the stern bearing and up through a pipe above the water line, and allowing it to flow back into a small tank so that it could be used over again after passing through a strainer. I have, however, not yet been able to carry out the whole of my idea, although I had it all drawn out and the pump ready for fitting, as Mr. Macdonald, the chief engineer of the *Star of Australia*, and one in whose judgment I place a great deal of



STEAM YACHT SKIBO FOR CRUISING IN SOUTHERN WATERS.

confidence (although I sometimes take my own) was rather nervous of starting on a voyage of six months with something he had not tried. The details of the stern tube have been carefully thought out, the longitudinal and fore-and-aft ribs giving great stiffness for the amount of material used. Another point which requires attention is making the joint on the bulkhead by an india-rubber ring. The stern tube is coned in to the stern post and provision made for forcing tallow round the coned end of stern tube to facilitate its being readily drawn in for examination. It is quite easy to renew the lignum vitae, as it can be kept ready fitted. I would make a slight improvement in the *Star of Australia's* shaft by hollowing out the liner close up to the propeller boss, which would be equivalent to tapering the liner at the end, while still retaining a suitable form to hold the india-rubber ring next the propeller boss. If the propeller shaft is fitted as I have described, of ample size of the best material with extra bearing surface, and none of the shaft exposed to the action of the salt water, you have done as much as I know how to insure its efficiency and safety.

Shamrock III.— Press dispatches advise that William Fife is to build Sir Thomas Lipton's next challenger.

Steam Yacht Skibo.

There has just been completed at the Crescent Shipyard, Elizabethport, N. J., a steam yacht of unusual design built to meet special requirements of navigation in southern rivers. The yacht is owned by Mrs. Lucy Carnegie and is for use in day excursions on the rivers and bays on the southern coast. The profile and general arrangements are given in the accompanying illustration. The vessel is 82 feet long overall, 72 feet on the water line, 11 feet 6 inches molded beam, 9 feet 6 inches molded depth, draft 7 feet aft, and 5 feet forward. She has a bar keel 5 by 1 inch, a wrought iron stem and stern post 5 by 2 inches. The frames are two by 1 1-2 inches by 2.7 pounds angles. The reverse frames extend only across the top of the floors and are 2 1-4 by 2 1-4 inches in engine and boiler rooms, and 1 1-4 by 1 1-4 inches elsewhere. The floors are 12 inches by 5.73 pounds. The dock stringer is 14 inches by 5.73 pounds.

The design of this yacht is unusual in may respects. The character of the water of the southern rivers is such that it cannot be used for boilers, therefore, a large tank has been fitted under the boiler room floor. Coal bunkers of exceptionally large size for this little boat will store enough coal for a long trip. Forward is a large cabin for the crew, with berths for four men. Aft of the engine room is the ladies' cabin with accommodations for three. An unusually large cabin is located forward comfortably furnished, and at the forward end of this is a steering wheel. With the exception of the low hatches and companion ways the deck is clear from this cabin aft, and an awning will be stretched the entire length. Above the forward cabin is a bridge deck, and the vessel may also be steered by a hand wheel connected to the one in the cabin. Forward is an anchor davit and small capstan. It is the intention of the owner to use the boat for day excursions, therefore no provision for cooking on board has been made.

The vessel will be driven at the maximum speed of about 13 knots by an engine with cylinders 8, 12, and 18 inches in diameter by 9 inch stroke. Steam is supplied by 1 water tube boiler 7 feet long, 5 feet broad, and 5 feet 4 inches high.

The *Skibo* was launched with engines and boilers in place and all joinery work completed, so that a few days later she was able to proceed South under her own steam.

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FROM a mountain top one sees a wide stretch of country, with its characteristics of hill and vale, lake and river, field and forest, all in one sweep of the eye and without noting the minor characteristics of any one feature. It is well at times for the engineer to take a similar view of his field of work, the better to note the general progress as a whole, to compare the condition of one part with that of another, and to thus enable him to use his own efforts in that part where they are most needed or where they will be most effective.

One of the bold features which the marine engineer would see in taking such a survey of his field of work is that involved in the general problem of the economical development of power by the steam boiler and engine. We know that wastes and losses are constantly occurring all the way along from the coal bunker to the piston rod, where the forces exerted by the steam are first manifest. To what extent can these various losses be reduced or eliminated? Or, in other words, to what extent can the margin which now exists between the highest thermodynamic ideal and actual existing practice be wiped out? To what extent can we profitably carry the existing tendencies toward higher and higher steam pressures? To what extent, if any, can we profitably go beyond the present practice with triple and quadruple expansion engines in breaking up the total expansion into a series of stages? Or, in other words, to what extent, if at all, will the quintuple or sextuple expansion engine find a place in recognized practice? Again, to what extent will the use of superheated steam make possible higher economies, and to what extent will its introduction react on the general problem of steam boiler and engine design? Or, in another direction, to what extent will improved practice with auxiliaries and with the intelligent use of feed heaters and other means of preventing the final loss of heat improve the existing economy of the steam plant as a whole?

Again, beyond the steam boiler and engine, are there possibilities deserving careful study in any of the various forms of gas or internal combustion engines? If so, what form will the most efficient equipment take? Again, beyond the gas engine, what of binary vapor engines such as the so-called waste heat engine recently developed by Professor Josse, of Berlin? Are there to be possibilities in the use of electricity from storage batteries deserving of more serious attention than at present? In short, what is to be the future source and method of developing power for ship propulsion? This most fundamental of all problems may well occupy our serious consideration and study.

WE publish on another page the first instalment of a comprehensive digest of the prize paper by Naval Constructor D. W. Taylor on the balancing of marine engines, read before the Society of Naval Architects and Marine Engineers in November last. A portion of the mathematical appendix will be omitted, as well as occasional paragraphs elsewhere, and in some few cases the substance of a paragraph is given in condensed form. The purpose is, however, to publish this admirable paper in a form sufficiently complete to give to our readers the essential features, especially as regards the practical application to the problem of engine balancing. We would therefore commend this paper to the careful study of all who are interested in this subject of so great importance in present-day practice.

THE condition of the ship building industry throughout the year has been worthy of note in several particulars. While the coast yards have been full of work, while all have shared in good measure in the continuance of our general prosperity, and while many important contracts have been made, it is a fact of interest and importance that no contracts have been made during the year for vessels to engage in the foreign trade. Several large ships are, of course, building in the coast yards for the foreign trade, but these were all contracted for previous to 1901. The contracts of the year have been for coastwise service. The reasons for absence of orders for vessels for foreign trade are doubtless complex and difficult to analyze beyond a certain point. The fact that a shipping bill was likely to be presented at this session of Congress and the uncertainty regarding the provisions of such bill, doubtless had much to do with this hesitation on the part of those who may be inclined to invest in our foreign carrying trade. Again, it is a fact that but few have thus far shown any tendency to enter this field of investment, and those few already have several ships building, and for the moment do not desire more. Again, it may be that there is some apprehension that our present era of prosperity is not to be much longer in duration, or at least that we shall soon pass the crest of the wave and enter a period of decline, how sharply pronounced no one can now tell. These and other motives more or less obscure may be invoked to explain this absence of orders for foreign trade, but the point still remains.

Another notable fact is the absence of naval contracts for the year. This, however, has no special significance, as with the building program in hand it was not desirable to add during the year to the work already in hand. The extent of the naval work now in hand may be gathered from the statement that the total number of war ships under construction is fifty-one, their total displacement 264,987 tons, and their total cost $74,731,666.

The season in the Lake yards has been one of still greater activity than on the coast. New orders in large numbers have been booked, and the American Shipbuilding Co., consisting of the consolidation of the leading Lake yards, was months ago forced to decline further orders for delivery in time for the coming season of navigation.

In these latest types of Lake construction one or two interesting facts may be noted. The first is found in the reaction from the large sizes, which a year or two ago represented the forefront of progress. While these ships of 450 feet in length were considered as representing the most efficient size, and there was a feeling that lengths would soon increase to 500 feet and more, we find on the contrary a pronounced falling off to lengths of from 400 to 360 feet. Doubtless one of the considerations which led to this reduction was the fact that no matter what the length, the draft is always limited by the depth of the shallowest channels which the vessel has to traverse, and there is small prospect of any pronounced improvement in the near future over the depths which now prevail. But with a fixed draft the depth is in consequence fixed, or nearly so, and in Lake practice at twenty-eight or thirty feet. Now with a fixed depth a greater and greater difficulty is found with increasing length in making the ship sufficiently strong and stiff. A length of 500 feet with a depth no greater than thirty feet forms an extreme proportion, which calls for very special and careful consideration from the standpoint of strength, even with the somewhat easier conditions commonly met with on the Lakes as compared with the open sea. Giving to this general consideration full weight and having in view the greater handiness and somewhat greater general availability of ships of more moderate size, and we doubtless have in large measure the explanation of the reaction so far as size is concerned.

Another noticeable point is the absence of water tube boilers from the latest outfits. It has been understood that this was not due primarily to any prejudice against this type of boiler or to any failure or general dissatisfaction with those previously installed, but rather to the fact that their cost is somewhat greater than that of shell boilers, and that the builders of water tube boilers have been too busy with naval work to care for mercantile orders at prices which would compete with those of shell boilers.

On the whole the season has been one of pronounced prosperity for the ship builder. If the future contains nothing worse he will have small reason for dissatisfaction. In one chief point the coast builder may feel more lack of satisfaction, and that is with reference to orders for foreign trade, as referred to above. We may hope that the future contains better things in store, at least in this respect.

THE CONTEST FOR THE PRIZES.

The contest closes with this issue and the result will be announced in March.

Further contributions on this subject will be received and all articles published will be paid for at the usual rates.

Repair of a Tug Boat Boiler Furnace.

The boiler is of the return fire tube type with two furnaces. The diameter of the shell is 8 feet 6 inches and that of the furnaces 31 1-2 inches. The furnaces are of the Adamson ring type, as shown in Figs. 1 and 3. The original condition of the furnace is shown by the dotted lines. In the same drawing is also shown the diminution of thickness and the half section of the repair completed. At *c* the plate was broken through. On the other side in *f*, Fig. 2, the plate was not broken but was reduced to a thickness of 1-16 to 1-8 inch. There was leak also at the point *d*, Fig. 3. After examination of the furnace about the damaged locality, and considering that the boiler was already 10 or 11 years old, it was decided to fit a piece over the weakened portion and on the fire side, as it seemed impossible to properly fit it in on the water side. The steps in making this repair were as follows:—

(1) The thickness was first tested with a hammer in order to determine the suitable size of patch.

(2) The size of the piece was approximately drawn and the location of rivets determined. Small holes were then drilled at the center of rivet holes in order to measure the true thickness of the plate. This was found to be 1-4 inch or slightly more. The diameter of the rivets was taken at 11-16 inch and the pitch at 2 inches, while the thickness of the patch was 5-16 inch.

(3) The furnace plate was thoroughly scraped and cleaned.

(4) Patterns were taken along *HI, JK, MNO.*

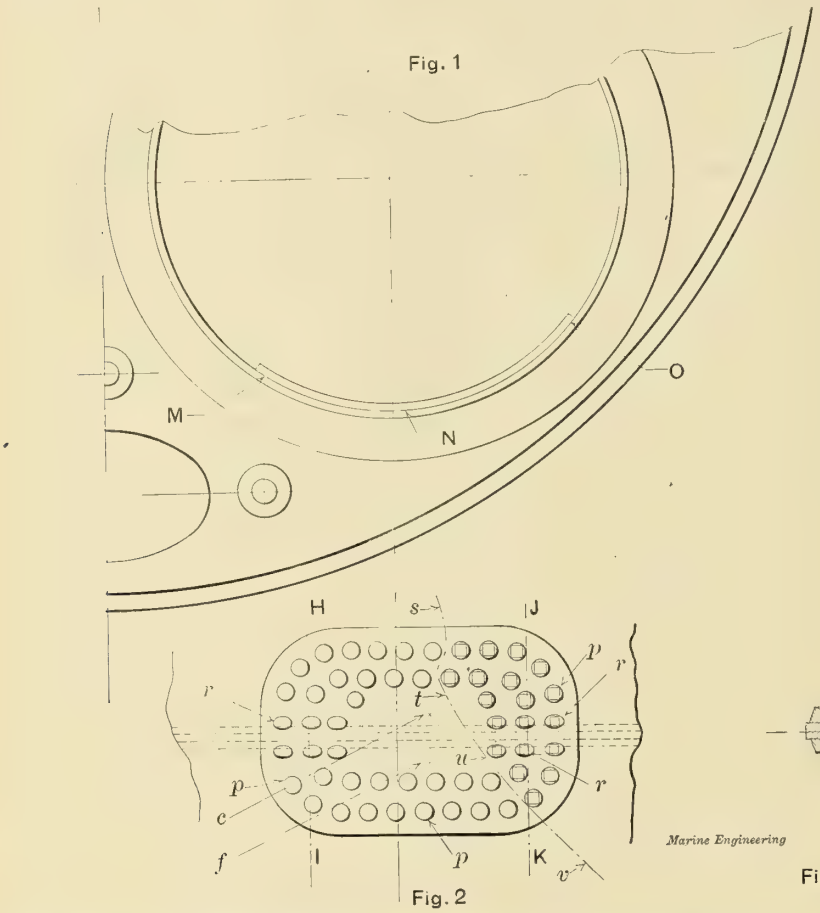
(5) The patch was made according to the patterns as well as possible by fitting and correcting as many times as necessary.

(6) Holes *p* were drilled in the patch and fitted with bolts. The patch was then heated red with a blast lamp and fitted as well as possible, especially at the flange.

(7) The size of the patch and the layout of the rivets were then finally drawn.

(8) Care was taken that the rivets situated near the flange were well drawn in, remembering that the holes were inclined as in Fig. 3.

(9) On the right of the piece the space was too small to allow holding on for riveting so that it was impossible to fit rivets on this side of the patch. After careful examination a line *s, t, u, v,* was drawn limiting the holes where rivets could be driven. The other holes on the right were provided with screws as in *x*, Fig. 3.



(10) Holes on the left were drilled at the correct diameter for the rivets. Holes on the right were drilled at a diameter smaller by 3-32 inch for screws like *x*.

(11) Holes for the screws were tapped through and through.

(12) All the holes on the patch were countersunk. It was found impossible to make the fit very perfect at the flange and in the groove. It was therefore decided to fit putty between the patch and furnace along the groove. This putty was made of sifted iron filings and white lead, mixed with a little sulphur.

(13) The putty was laid on and the patch fitted with temporary bolts.

(14) The screws were put in the holes on the right and tightened well, also the bolts.

(15) The rivets on the left were then driven. It was possible for a man to enter the boiler to hold on.

(16) The rivets, the patch and the heads of the screws were then caulked, holding on where possible on the other side.

This repair was made in March, 1901, and the tug is still in regular use. V.

Repairs Under Adverse Circumstances.

Speaking of mishaps! Well, I have had a few in my time. I will relate my experience in one instance which, though of no great moment so far as expense was concerned, was trying to say the least, and was not without its amusing features.

It happened during the summer of 1880, at the time of the Skagit river gold mining excitement, when all the available small river steamers (stern wheelers) were pressed into service. The river grew smaller, shallower and more rapid as the head of navigation was reached, and at times it was all the three little boats could do to reach their destination. Each tried to outdo the other, thus increasing the excitement of the trip. The result was a couple of safety valves got locked up and two boats dropped out of business. I was engineer of the *Chehalis*, one of the boats that staid on the run as long as there was any business, and the experience I am about to relate happened on one of the trips made during a freshet in the Skagit river. In those days machine shops were few and far between, and much depended upon the skill and ingenuity of the engineer to keep his job in good running order. Just before this particular trip the boat was fitted with larger cylinders, and at the time of which I write I found it necessary to renew the gaskets of all the cylinder heads. The sheet-packing which I procured was, as it proved later, of very poor quality, and the cover bolts were pitched farther apart than they should have been. We had not proceeded very far on our way from Seattle when the cylinder heads began to whistle and I soon had a full-grown edition of a bird store to entertain me. The boat was crowded with gold-seekers, good natured every one of them, and I soon had the engine room filled with an interested audience. Many were the suggestions made, a few of which I heard above the din which was a sort of screeching in various keys. The engine room force consisted of myself and a fireman, and we had our hands full. As the passengers were so ready to help I started some of them in whittling to keep me supplied with pine wedges, for I found that I could not whittle and drive them in fast enough for now and then one would "piff" and fly out skyward, and the noise would reach a crescendo pitch. Before I got through I had the heads bristling with pine sticks, while from behind the bolts, where I could not get at the leak very well, would come unearthly shrieks that were simply hair raising. In despair I covered the cylinders with old sails and tarpaulins in an effort to stifle the noise, and stood by the levers with my hand on the gong lever so that I would know when a signal was made, as it was impossible to hear the ring of the gong. My main object was to keep the boat going, as we had rapids to jump and rocks to dodge. Finally a stop was made to take on wood for fuel. This was a short operation, for passengers and all took off their coats and went at it. The captain came into the engine room and asked me what I was going to do. Pointing to a reel of white rubber hose, I replied that I was going to take enough of it to renew those infernal joints if he would permit it. He gave me permission, and so while others turned to and cut the hose into strips I took off the cylinder covers and in due time had all four joints renewed with rubber hose for packing, and we were again on our way. The boys viewed the proceeding with some misgivings, but I knew that hose would hold as I had used such material for the purpose before. They were soon assured and a shout went up in cheer for the pine wedge engineer.

Things went along swimmingly for a while, and promised to end without further mishap. The little boat was laboring along under all the steam allowed; progress was slow, for the current was strong and the water was shallow. We had proceeded to within a few miles of our destination and the passengers were becoming impatient when the main feed pipe burst with a long split. "I drowned a black cat just before I left." Here was a pretty pickle to be in, and many miles from anywhere! I needed no time to think, for just as soon as the boat was secured to the river bank I proceeded to take down the feed pipe and set the fireman to pulling down the copper jingle bell wire. Any old thing would do to ring that bell with. I cleaned the surface of the pipe, which was a copper one, around the leak and coated it with soft solder, then began wrapping the pipe over the leak with the bell wire, which had been scoured with emery cloth, and soldered it to the pipe with a good hot bitt as I laid the wire on, at the time having someone hold a hot piece of iron against the pipe to keep it hot. When finished the pipe was stronger than when new, and in less than two hours we were proceeding on our way and returned home without further incident. I have always since then kept a roll of about No. 16 tinned copper wire and soldering kit on hand for just such emergencies and have found that it filled the bill several times.

While these incidents amounted to very little in themselves, they show how one may keep his boat going with meager resources at hand.

PINE WEDGE.

Repair of a Boiler Furnace.

This boiler was of the return fire tubular type, half cylindrical vertically with two flat sides. There were two furnaces strengthened with Adamson rings. One of the furnaces was broken through, as shown in *a*, Fig. 1, and *b*, Fig. 2. There was also a diminution of thickness around the hole. After examination of the mishap and considering the space available to receive a man, it was decided to fit a patch on the water side of the furnace. The repair required the following operations.

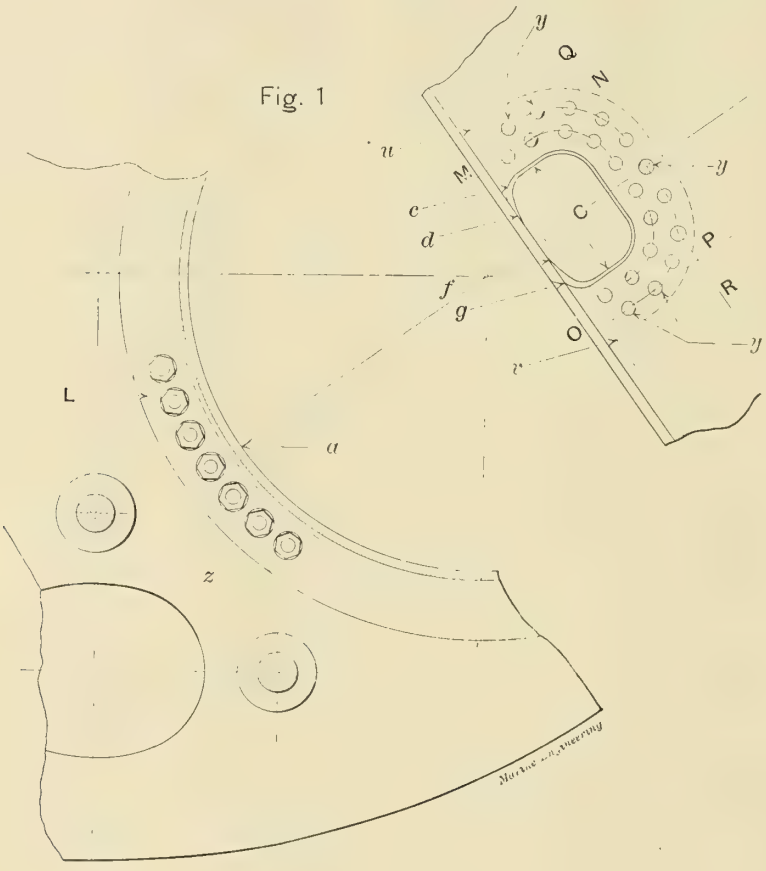
(1) To increase the hole *b* so that the thickness of the furnace in this neighborhood could be measured. This was found to be 3-8 to 7-16 inch. The size of the hole thus enlarged was then laid out on drawing paper, the size of the patch determined and the lay out of rivets. The diameter of the latter was taken at 11-16 inch and the pitch about two inches. At the same time care was necessary that the patch could be introduced into the boiler from the manhole.

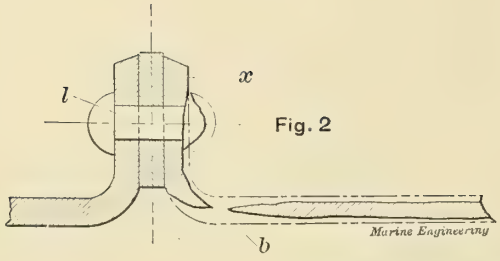
(2) The hole was then trimmed to the final size, and the rivets *l*, Fig. 2, were removed from the flange by cutting the heads and drilling out the bodies. Care was taken to cut the flange *x* in *d* and *f* so that the interval *df* should be smaller than the breadth of the hole for 4 or 5 inches. The flange was also made as thin as possible at *c*, *d*, and *f*, *g*. This can be done by working in the furnace.

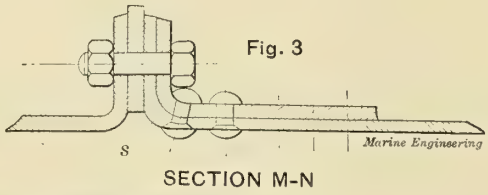
(3) Take patterns along MN, OP, QR, and *u*, *c*, *d*, *f*, *g*, *v* from which to make the patch.

(4) Make the patch of mild steel of 3-8 inch thickness according to the patterns.

(5) Fit the patch in place and correct it several times if necessary so that it fits very well.







ILLUSTRATING REPAIRS MADE TO A BOILER FURNACE.

(6) Drill in the furnace some holes *y* about 1-16 inch smaller than the true diameter of rivets.

(7) Mark on the patch the holes *l* and *y*.

(8) Shift the marks of the holes *y* out of place 1-16 inch, as indicated in Fig. 4, the holes in the furnace being nearer the flange than the holes in the patch.

(9) Drill the holes of the same diameter as in the flange.

(10) Fit the piece by bolting first with temporary bolts *l* and with two or three bolts *y*. Then tighten them hard. Put a broach in the other holes *y* with a hammer, and in this manner the holes will come fair and a perfect fit will be secured in the angles *s*. Then put bolts in all the holes and tighten them.

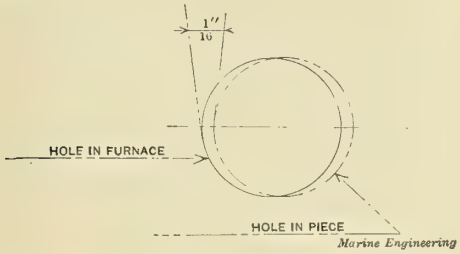


Fig. 4

(11) Drill the holes remaining in the two plates to the true diameter of the rivets.

(12) Heat the patch to redness with a blast lamp and finish the fit with a hammer.

(13) Fit bolts in the holes drilled to the true diameter of the rivets.

(14) Take out the first bolts *y* and bore these holes to the true diameter. Bore also the holes in the flanges *L*, and fit in these holes body bound bolts. Tighten nuts with a box wrench.

(15) Then rivet up the piece. The rivets have flat heads on the inside and are countersunk on the outside.

(16) Caulk carefully the side of the furnace.

In this case the repairs were carried out in the manner above described and the hydraulic test was successfully passed.

QUERIES AND ANSWERS.

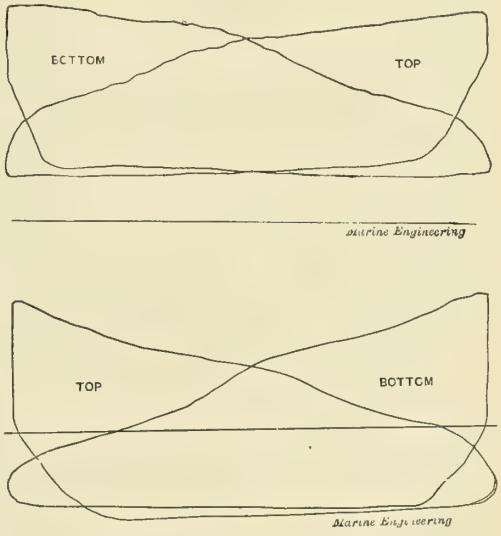
Q. I would like to know if there is any economy in heating feed water with live steam from boilers. The feed water from the air pump is 122°, but by using a heater it is raised to 150°, but to raise it live steam is used. Please let me know if there is any saving in fuel by that process. L. J. P.

A. There is no direct gain in heat by the process which you describe. Many engineers consider that a boiler steams easier and lasts longer when fed with hot rather than cold feed water. Other things being equal, and to this extent there may be some slight advantage gained. In the use of a feed heater the effort should be made to use heat which would not be otherwise utilized, as for example the exhaust of some pump of other auxiliary which is not sent to the condenser. There are feed heaters arranged to be used on the so-called step by step process. In this steam is drawn from the series of receivers of a multiple expansion engine and raises the water successively to a higher temperature. In other words, the steam here used is sent to the heater after having done some work in the engine, but before it has done all that it could. In such cases it can be shown that there is a definite saving. Where, however, the sole source of heat is boiler steam of full pressure, the only advantage will be that possibly resulting from a little easier operation of the boiler, or a little more effective use of the fuel burned in the furnaces.

Q. How many pounds of water at 67° Fahrenheit can be changed to steam at a pressure of 90 pounds per square inch gauge by the burning of 7 pounds of hydrogen, assuming that 23 per cent of the heat of combustion is wasted? J. H. A.

A. (2) The total heat of combustion of one pound of hydrogen is usually taken as 62,000 heat units. If there are seven pounds and if 77 per cent is available this will give for the available heat 7 x .77 x 62,000 = 334,180 heat units. The total heat of steam at a pressure of 90 pounds gauge and above 67°, as taken from the steam tables, is 1,147.8 heat units. Hence the number of pounds of water which can be transformed into steam will be 334,180 ÷ 1,147.8. Dividing this out we find 291. Ans.

Q. Inclosed you will please find a set of cards from a vertical compound (inverted) engine, which I would like to ask you if they could be improved on in any way by valve setting. The high pressure card is a piston valve taking steam on the outside, and the low pressure valve is a slide valve. Please let me know if the engine could be made any more economical, or if you consider the cards good. The size of engine is 44, 75 inches by 51 inches stroke. Steam is throttled at the stop valves on boilers on account of lifting water. G. J.



Pressure at Boilers	92
" " High Pressure Cylinder	78.5
" " Receiver	15.0
" " Low Pressure Receiver	9.5
Revolutions per minute	75
Mean effective pressures:—	
High Pressure Cylinder	39.2
Low Pressure Cylinder	14.25

A. The cards shown are on the whole very good ones. There is some drop in the admission line showing a little wire drawing through the ports, and indicating that a slightly larger port area or opening would be desirable. This is but slight, however, and not more pronounced than is often met with. To judge from the cards the lead is also rather small. Moving the eccentric a few degrees ahead would remedy this but at the same time would give an earlier cut-off with a correspondingly reduced power. The smoothness of running is often dependent on the lead, and it might be that any attempt to increase the lead would result in less satisfactory running than at present. In any event no slight change of this character could have any noticeable effect on the economy. The low pressure cards are also excellent in general appearance, though here also a little increase of lead might be suggested, and perhaps a little later exhaust closure on top. Regarding the distribution of power between the cylinders it is found to be about in the ratio high to low, 1 to 1.06. This shows a very equal distribution, or at least much more so than is commonly met with in engines of this class. The chief limitation to economy in the engine is in the moderate steam pressure employed and in the correspondingly small number of total expansions which the engine is designed for. These, however, are not matters which can be improved by valve setting, and it is probable that so far as indicator cards show, no great improvement in economy is to be expected from any readjustment of the valve gear.

Q. Given an ordinary four-bladed propeller wheel of a certain size and pitch. If it is submerged in a current of water flowing at a known rate, is there any way of finding the power that would be developed? P. P. W.

A. There is no way with our present knowledge of the screw propeller of telling how much power could be developed in such a case. The usual formulae for the design of screw propellers or for the power which they can absorb under the usual conditions do not apply under the circumstances which you describe.

Q. (1) A boiler shell is 63 inches in diameter, and is made of steel plate 3-8 inch thick; what maximum working pressure would you allow? If required to carry a pressure of 135 pounds per square inch, what should be the thickness of the plate? J. H. A.

A. The U. S rule for the pressure allowed on marine boilers is as follows:—

Rule. Multiply one-sixth (1-6) of the lowest tensile strength found stamped on any plate in the cylindrical shell by the thickness—expressed in inches or parts of an inch—of the thinnest plate in the same cylindrical shell, and divide by the radius or half diameter—also expressed in inches—and the quotient will be the pressure allowable per square inch of surface for single riveting, to which add 20 per cent for double riveting, when all the rivet holes in the shell of such boiler have been "fairly drilled" and no part of such hole has been punched.

Following this rule, we have in your case, assuming the steel to have a strength of about 60,000 pounds per square inch:—

$$p = 10{,}000 \times \tfrac{3}{8} \div 31.5$$
$$\text{or } p = 119 \text{ pounds.}$$

To this we may add 20 per cent, if the joints are double riveted, as they probably would be. This would give 119+23.8= 142.8 or 142 pounds as the nearest whole number below. For a working pressure of 135 pounds the thickness worked out by the same rule would come a little less than 3-8 inch, but so little that 3-8 would be the nearest regular thickness to be employed.

Q. How is the counter electro-motive force of motors ascertained? B. L. D.

A.—The counter e. m. f., or back pressure of a motor, is determined for any given strength of current by passing that current through the armature when it is held stationary, and measuring the voltage by means of a volt meter. This measurement gives the voltage absorbed by the armature resistance for this particular strength of current, and this voltage deducted from the voltage applied to the motor when running with the same current strength, gives the value of the back pressure or c. e. m. f. For example, suppose that we hold the armature of a motor still and pass 100 amperes through it and find that a volt meter connected with the brushes indicates three volts, then if we set the motor in motion with a current having a voltage of 100, as indicated by a voltmeter connected with the brushes, when the current strength is 100 amperes, the counter e. m. f. will be 97 volts; that is, 100 volts less 3 volts absorbed by the armature resistance. As the current passing through the motor armature varies with the load, the voltage absorbed by the armature resistance must vary, and as a natural consequence the counter e. m. f. must also vary, so that the c. e. m. f. can only be given accurately for some particular strength of current.

Q. How can I determine the voltage and strength of current required to charge storage batteries? Does it make any difference whether the current is strong or weak? What time does it require to fully charge a battery? How long will it furnish a current when it is discharged? CHICAGO.

A.—(1) Storage battery cells require about two and four-tenths volts to fully charge them: therefore, assuming that the battery is charged in series, as is usually the case, the voltage required for any battery can be determined by multiplying the number of cells by 2.4. The strength of the charging current will depend upon the size of the cells, and should not be so strong as to charge the battery in less than three hours, and if time is not an object the charging should not be done in less than six or eight hours. The proper strength of current can be obtained from the manufacturers of the cells.

(2) It makes a decided difference whether the current is weak or strong. The stronger the charging or discharging current, the greater the percentage of the energy that is lost in the battery and the more rapidly the latter will deteriorate. Weak currents not only mean higher efficiency, but also longer life for the cells.

(3) The time required to charge a battery depends upon the strength of the charging current, the manufacturers give this information for the different sizes of cells.

(4) The time during which a battery will furnish current on the discharge will depend upon the strength of the current, and as in the case of the charging current the information can be best obtained from the makers as the time does not vary in a proportional ratio with the current strength, but increases faster than the current decreases, and the ratio changes with the different sizes of cells, and also with different makes.

THE PROFESSOR ON SHIPBOARD.

Story of an Attempt to Combine Theory With Practice.

BY C. A. MC ALLISTER, FIRST ASSISTANT ENGINEER, R.C S.

CHAPTER VI.

When the Professor regained consciousness he found himself lying in his berth, with the doctor standing over him. A dim recollection of what had happened gradually dawned on his mind, and in a feeble voice he inquired of the medical officer his opinion as to whether he was going to die or not. To this the physician replied in a very cheerful manner that there was nothing serious the matter with him, and that such accidents were of somewhat frequent occurrence to the men in the engineer's force. Feeling somewhat encouraged, the Professor lapsed into a meditative mood and tried to recollect the circumstances attending his attack. He could remember distinctly that he was standing near the air pump when the thing happened; he had an indistinct memory that the air pump began to roam around the engine room and that the grating flew up and struck him. Beyond that all was a blank, and he shuddered to think of what he had been through. The doctor gave him a little stimulant and he gradually began to take interest in his surroundings. In the afternoon his brother, who had been greatly worried over his brother's prostration, came into the stateroom and spent several hours with him. The chief succeeded in cheering him up considerably, but could not resist the temptation to joke with him good naturedly about his present idea of the theory of heat and thermodynamics.

Under the cooling influence of an electric fan and the gradual administration of nourishment the Professor's condition was so much improved the next day that the doctor allowed him to sit out on deck in a comfortable steamer chair. On the afternoon of the same day Barney, the oiler, who was "off watch" at the time, came up to the convalescent, and, making a bow, said: "Professor, I'm glad that you are able to be around. Shure I thought you was a goner this time." The Professor thanked him very kindly for his friendly expression, and told him to draw up a chair and sit down alongside him. Barney said that he would like to, but he was afraid that some of the deck officers "would chase him off," as he expressed it. The Professor assured him that he would make that matter all right if anybody questioned the propriety of the oiler sitting on deck among the passengers, so Barney got a camp chair and sat down. As the Professor did not feel much like talking, Barney took advantage of the opportunity and spun a number of yarns in regard to the many funny experiences he had encountered in his travels. These put the college man in a good humor as he laughed heartily at a number of the Irishman's witty tales. Finally the conversation turned to the subject of engine room heat and the discomforts encountered in the engine and fire rooms of steamships. Barney assured the Professor that it "was all in getting used to it." To this remark the Professor shook his head and said that he was afraid he would die in the attempt. Barney said: "Oh, never mind, it won't be long before they'll be running

all steamships by electricity, and all the engineer will have to do will be to sit down in an arm chair and open a switch." The Professor replied that he was afraid that that happy state of affairs would not be brought about in their lifetime.

"You see, Barney," he continued, "that the only method by which electricity can be developed on board ship at the present time is by the steam engine. Storage batteries are used to some extent on launches and small yachts, but they can only travel short distances, and must never get a great distance from the power station. So long as electricity has to be generated by a steam engine it will be of no practical utility for ship propulsion. The marine engine of today is, at the best, very inefficient, and it would be still more so if an attempt was made to apply the power to the propellers through the medium of electricity."

The first assistant engineer, who was also off watch, happened along in time to hear this last remark, and as he looked upon Barney as a sort of privileged character, he also drew up a chair and sat down."

"Professor," he said, "what do you mean by saying that the marine engine is very inefficient? From what I have read on the subject I have always understood that a marine engine was about the most efficient type of engine made, and especially when compared with the ordinary type of stationary engine."

The Professor replied: "Yes, that is true, Mr. B——, and perhaps it would have been well for me to have said that any steam engine is very inefficient from a theoretical standpoint. You can readily see that the only way that the efficiency of a steam engine, or in fact any other kind of an engine, can be determined is to compare the actual power developed by the engine and applied to the propulsion of the ship, with the power that should be developed by the consumption of the fuel if none were lost in the process of conversion. It will no doubt surprise you when I state that with the very best types of marine boilers and engines not over 15 or 20 per cent of the power supposed to be developed from the amount of coal used is usefully applied in driving the ship."

To this his listeners both expressed surprise, and Barney remarked that he "knew mighty well that thim firemen didn't half burn the coal in the furnaces."

"Oh! it is not careless firing that accounts for this waste," replied the Professor, "although of course that accounts for a small part of it." The first assistant evidenced a great deal of interest in the Professor's remarks, and asked him if he would not explain wherein there was such a great lack of efficiency. To this the college man readily assented, and after drinking a glass of lemonade which one of the waiters had brought him, he proceeded thus: "You see, scientific men, by a series of experiments in laboratories, have determined that the perfect combustion of one pound of coal would produce on an average about 14,000 British thermal units."

Barney said: "I don't know phwat that is, but why don't they use Irish units?"

This caused the Professor to smile, and he replied that they probably would have called them Irish thermal units if an Irish scientist had determined their value. "However," he said, "a B. T. U. is the amount of heat that is necessary to raise the temperature of one pound of absolutely pure water one degree on the ordinary Fahrenheit thermometer. On board ship it is not possible to burn coal and obtain a perfect combustion such as was done in the laboratories. This is accounted for owing to the impossibility of having furnaces designed to suit the various kinds of coal met with at different ports, and to regulate the admission of a proper amount of air. This imperfect combustion results in the escape of unconsumed hydrocarbon gases, and in the formation of what is known as carbon monoxide, evidenced by a blue flame, which passes off through the stack. Ordinary coal consists of from 75 to 80 per cent of carbon, 2 to 5 per cent of hydrogen, 10 to 15 per cent of oxygen and small percentages of nitrogen, sulphur and ash. The constituent which produces the heat is principally carbon, although hydrogen and sulphur aid a little. This carbonic oxide takes a portion of the carbon away without producing any heat."

"It must be a regular robber," said Barney.

"Yes, you can call it that," said the Professor, and continuing, said: "another great source of waste is that considerable of the heat applied to the water is lost on account of the radiation. Dirty tubes, or tubes partially stopped up by soot are also accountable for more waste of the heat of combustion. The chief loss of the heat is, however, that which goes up the funnel with the waste products of combustion. A certain temperature of these waste gases is, however, necessary for the maintenance of a suitable draft, so that this loss exists of necessity and cannot be reduced below certain limits. As a fair average it can be said that with the ordinary coal used on shipboard, and with a well designed boiler, it is only possible to transmit to the water and steam, under favorable conditions, about 65 to 70 per cent of the heat which would be produced by a perfect combustion of the coal used in the furnaces. The remainder of the heat is absolutely wasted, so that out of every 100 tons of coal bought by the steamship owners at least 30 tons might as well be thrown overboard, so far as any useful work is concerned. Now as to what happens in the boiler. In the first place if you should boil water in an open pot or kettle, that is as we term it, at the pressure of the atmosphere and place a thermometer in it, you would find that the temperature would gradually rise until it reached 212 degrees on the Fahrenheit scale. The mercury would then stop rising for some time, no matter how much fuel you would add or how much you forced the fire. After a while steam would form and escape from the surface of the water. During this time and while the thermometer was constantly showing 212 degrees, heat was constantly being added to the water, and eventually caused it to change from its liquid state into the form of vapor or steam. The heat absorbed by the water during this period is known as the heat of vaporization or latent heat. Although it only takes 180 thermal units to raise the temperature of a pound of water from freezing, or 32 degrees to the boiling point or 212 degrees, it has been found that it takes 966 thermal units to transform the water into steam at the latter temperature. The heat absorbed in bringing the water up to the boiling point

is known as 'sensible heat,' because it is indicated on the thermometer.

"Will that 'later heat' raise a blister on your skin as quick as the sinsible heat?" inquired Barney. The Professor was too much absorbed in his discourse to notice this interruption on the part of the oiler. Continuing, he explained that although water boiled at 212 degrees under atmospheric pressure, if confined in a closed vessel, the boiling point gradually rose with the pressure. At a pressure of 180 pounds in a boiler, the water would not begin to be transformed into steam until the thermometer registered 380 degrees.

When the steam leaves the boilers it, of course, passes to the main engines through the main steam pipe, and even in passing this short distance you may have noticed the pressure is somewhat reduced, owing to the friction in the pipes around the bends and through the stop and throttle valves. This drop in pressure indicates still further loss. When it enters the cylinders there is a certain quantity of it condensed into water, owing to the surfaces of the valve chest, cylinder passages, piston and cylinder heads being at a lower temperature than the steam itself. This loss of heat is attributed to 'cylinder condensation,' and amounts to considerable. Then there are losses of steam through leaky stuffing boxes. The very heat in the engine room which overcame me the other day is a great loss to the efficiency of the engine (not to mention the effect on the men in the engine room), as it is all radiated from the pipes or cylinders. The greatest engine room loss, however, is in the condenser. When the steam leaves the low pressure cylinder its sensible heat has been greatly reduced, so that it is now almost down to the original boiling point. Here, again, we have to contend with the latent heat. In order to transform the exhaust into water again the vapor has to pass through a molecular change. The heat thrown out in this change is transferred to the circulating water, and is passed out into the sea without having done any work."

Barney said: "We ought to set a trap in the outboard delivery valve and catch some of it."

"Well, my man, if you can devise any scheme to utilize a good proportion of this heat, your fortune is made."

"Shure that's aisy," said Barney. "Whin I was on one of the American liners they use to pump up the discharge water for the passengers to bathe in."

"Well," said the Professor, "that no doubt added to the comfort of the passengers, but I don't think it reduced the coal bills to any great extent."

"After all you have said," remarked Mr. B., "it does look as if a steam engine was not very efficient." The Professor then said, "I have only pointed out some of the losses due to the use of the steam. In addition to those we must also take into consideration that there is a considerable loss of power on account of the friction of the working parts of the engine, and in the thrust and stern bearings as well. Then, too, the loss due to the action of the propeller in the water must not be lost sight of."

"Can't some of these losses be reduced?" inquired Mr. B.

"Oh, yes," was the reply; "the estimates I have given you are such that are met with on an average ship, but on very carefully designed and ably managed vessels the efficiency I have named is considerably increased. For instance, in the consumption of fuel, the average ship fitted with a triple-expansion engine uses from 1.8 to 2.0 pounds of coal per indicated horse power per hour, but there are triple expansion engines in use where the consumption of fuel is reduced to as low as 1.5 pound per horse power per hour, and even to about 1 pound in rare cases. This gain in efficiency is accomplished by having well designed engines and boilers, the use of feed water heaters, the heating of the air furnished to the furnaces for combustion, the stoppage of all steam leaks in boilers, pipes, engines and stuffing boxes, etc. Careful firing also adds greatly to the efficiency of a steam plant. Perhaps the most important of these items is the heating of the feed water. It has been estimated, for instance, that on a ship where the feed water is pumped into the boilers at a temperature of, say, 100 degrees, if a heater is fitted which, without entailing any use of heat otherwise useful, raises the temperature of the feed water to 212 degrees, a net saving of nearly 10 per cent in the fuel will be accomplished."

"If that is so, why are not more feed water heaters used?" inquired Mr. B.

"I can only attribute it," was the reply, "to what may be termed 'old fogyism' on the part of old engineers. They go on the principle that feed water heaters were not used on ships when they first went to sea, and they can see no reason why they should use them at the present day."

It was now nearing eight bells, and the first assistant and Barney, who had to go on watch, took leave of the Professor, after thanking him for what he had told them. The Professor spent an hour or so looking out over the blue water and watching the flying fish arising in flocks when chased by some hungry dolphin. Being still somewhat weak and tired, he gradually fell into a doze, to dream of distant places where there are no broken gauge glasses nor hot engine rooms.

Steamer Shawmut. — The Shawmut and her sister ships, described in Marine Engineering of January and building at Sparrow's Point, Md., was also classified under the rules of the American Bureau of Shipping.

Sea Lighters.—The use of lighters in transporting cargo at sea is being introduced by various Continental companies, including England, Russia, Norway, Sweden and Denmark. The North German Lloyd and Hamburg-American lines have each a small fleet of these lighters. The advantages of this means of transportation have long been realized in our own country, and the fleet of lighters plying along the Atlantic coast is annually increasing. At present they are used chiefly in the coal trade, but already companies have been formed to extend this class of service to general merchandise. The number of advantages claimed are the small cost of operating, rapidity of discharging or taking loading (therefore decreasing the time for lying in port), the small capital invested when compared with steamers of the same tonnage, and small expenses of maintenance.

ENGINES FOR DIRECT CONNECTED SETS.—II.

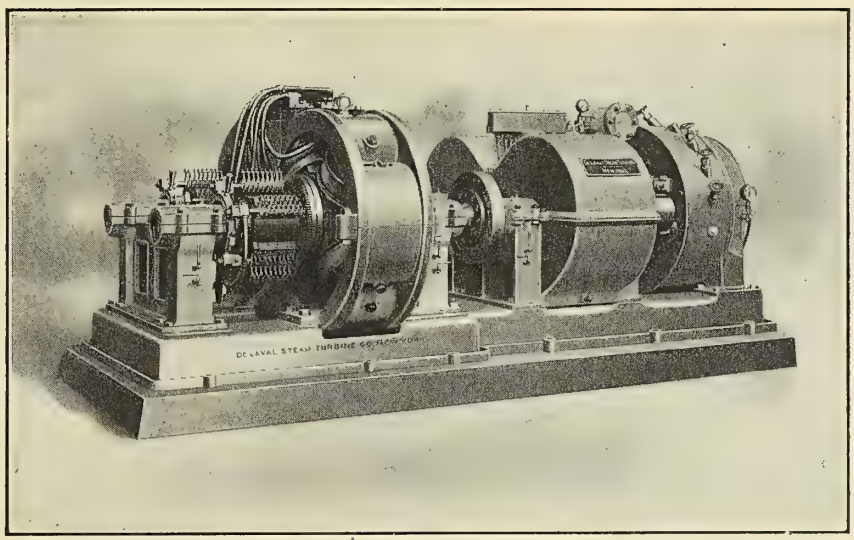
The De Laval Steam Turbine.

In the usual form of steam engine the conversion of heat into mechanical work is effected by using the internal pressure or expansive force of the steam to move a piston to and fro within a closed chamber or cylinder. In the De Laval type of steam turbine the conversion is brought about in quite a different manner. By the use of a divergent nozzle of special form a complete adiabatic expansion of the steam is effected from its original condition down to the lowest pressures practicable, with the complete conversion of the heat energy between these two conditions into kinetic energy of motion in the jet. With the non-condensing turbine the lowest pressure obtainable is of course atmospheric. With the condenser, pressures of 1.47 to 2.94 pounds absolute, corresponding to a vacuum of 27 to 24 inches, may be obtained. This jet of rapidly flying particles of steam is received upon curved vanes and by reaction in the usual manner, the rotation of the turbine is effected.

Velocities of efflux as high as 4,000 feet are by no means uncommon, and by the usual formulae of mechanics it is a simple matter to compute the energy possessed by a jet. Such a jet applied in the most economical manner to the vanes would give about .11 horse power per pound of steam expended per hour, or would show a steam consumption of 9.1 pounds per horse power per hour. This, however, would require an excessively high velocity of the rim of the turbine, a velocity of 47 per cent of that of the steam, or of about 1,850 feet per second. As it has been, however, found difficult to produce a material for the wheels that, with ample margin of safety, would withstand a strain produced by the centrifugal force at this high speed, the actual speed is somewhat lower and does not at the present time much exceed 1,350 feet per second. This indicates a steam consumption of 9.8 pounds of steam per theoretic horse power.

To overcome the impossibility of producing a wheel accurately enough balanced to revolve about its center at such velocities without causing a side pressure destructive to plain bearings and a rigid shaft, a flexible shaft was designed and introduced as an essential feature of the turbine. With the advent of the diverging nozzle and the flexible shaft, the De Laval turbine has steadily progressed, thousands of machines in sizes from 3 horse power to 300 horse power having been built up to the present time, and outside of the United States, De Laval steam turbine companies are operating in Sweden, Germany, France and England.

For the best results the turbine should of course always be operated condensing. Not that the steam turbine cannot, as far as the mechanical results are concerned, be operated equally well with low pressures and non-condensing, and even then successfully compete with the reciprocating engine, but whenever the best economy in operating is sought for, high pressures and a condenser should be used, and as the difference and gain in economy in the case of the steam turbine is more marked than in the reciprocating engine it will be found in many cases, even for comparatively small sizes, of advantage to operate condensing, even in places where the scarcity of water would render the employment of a cooling tower necessary.



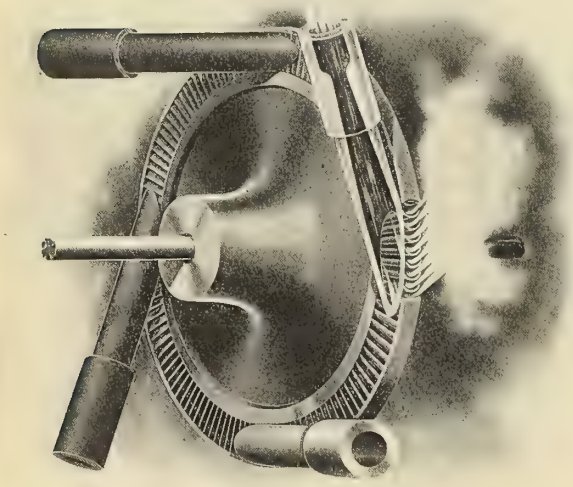
THE DE LAVAL STEAM TURBINE, 300 HORSE POWER.

A characteristic feature of the De Laval steam turbine is that none of its running parts are subject to the full pressure of the steam, as the steam is fully expanded in the nozzles before it reaches the turbine wheel. This feature, which will not be found in any other heat motor, is of great value and promising future in the direction of using high pressures with resultant increase in economy of fuel. The restriction as to the steam pressure that can be used is found only with the boiler, and as far as the steam turbine itself is concerned it has been operated successfully with a pressure as high as 3,000 pounds per square inch.

Further and considerable increase in economy can be attained by using superheated steam, for which the

De Laval steam turbine is particularly well adapted, it having no rubbing parts requiring lubrication, or packing glands in contact with the superheated steam, and, as in the case of high pressures, even here the limit exists alone with the boilers.

The De Laval steam turbine is therefore a high speed rotary steam engine, in design and construction adapted for all purposes where the common reciprocating steam engine is now used. This is especially the case where great efficiency, uniformity of rotation and close regulation are important, as when used in connection with electrical machinery, centrifugal pumps, fans, blowers, etc. Its high speed and the directness of its energy conversion decreases the dimensions and weight, and simplifies the construction without impairing its efficiency, advantages which do



DE LAVAL TURBINE WHEEL AND NOZZLES.

not exist with the modern steam engine where great bulk and complexity are features indispensable to highly efficient operation. Its principal advantages claimed are:

No leakage from wear.
Small friction loss.
High efficiency with variable loads.
No moving parts under pressure.
Simplicity of construction.
Perfect balance—small foundations.
Small space occupied.
Ease of erection.
Automatic oiling.
No danger from water, and long life.

The De Laval steam turbine is particularly well adapted for direct connection to dynamos, centrifugal pumps, blowers, fire engines, etc. All such units are built and tested in the works, which is a decided advantage over the old method of buying an engine from one place, a generator or a pump from another, and having them fitted together on the ground where used, oftentimes with great expense and delay, and probably a poor piece of work as the result. All machines are ready when taken from the car to be set down and operated wherever convenient, nothing being necessary but the connection of steam and exhaust, and switchboard connections in case of dynamos.

Further information regarding these turbines may be obtained from the De Laval Steam Turbine Co., 74 Cortlandt street, New York.

Parsons Steam Turbine.

The Parsons steam turbine is now being built by the Westinghouse Machine Company, of Pittsburg, Pa., and is called the Westinghouse-Parsons steam turbine. The first Parsons turbine with generator was built in 1884, made 18,000 revolutions per minute, and developed 10 horse power. It was used for several years at Gates Head, England, to supply current for incandescent lamps, and is now at the South Kensington Museum.

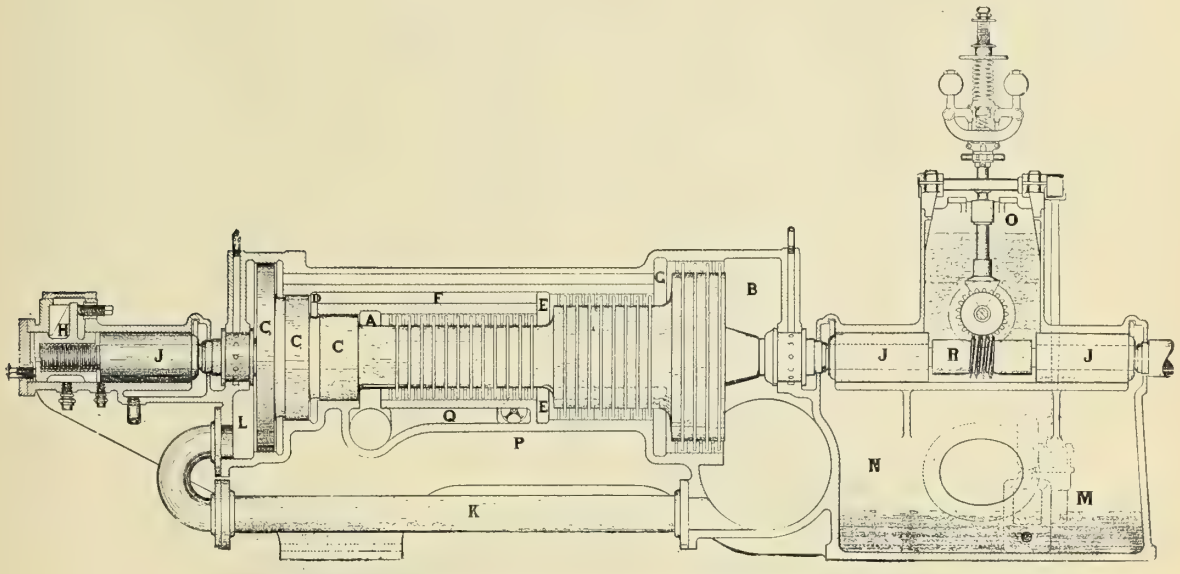
The Parsons turbine was described briefly in Marine Engineering of January, 1902. Herewith is given the longitudinal section for a Westinghouse-Parsons steam turbine. As the action of the two are similar it will not be necessary here to describe those parts previously mentioned. The steam entering the governor valve arrives at the chamber A, and passing through the three successive sets of turbine blades eventually exhausts into chamber B. The areas of the passages increase progressively in volume corresponding with the expansion of the steam. The end thrust is taken up by the balance pistons C, C_1, C_2, which are of the same diameter, respectively, as the three turbines. The pressure in front of each piston is maintained the same as that in the corresponding turbine by means of the connecting steam passages A, F and G—that is, the pressure at D is exactly the same as it is at E. In order that the machine will be more perfectly balanced, the pressure behind piston C_2, in space L, is maintained the same as in the exhaust passage by the connecting pipe K. Thus a correct balance of end thrust is preserved, no matter what the steam pressure may be. However, a thrust bearing H is provided to maintain the correct adjustment of the balance pistons, and is in two halves, the lower half capable of adjustment in one direction, the upper one in the reverse.

The bearings J are unique in construction. The bearing proper is a gun metal sleeve piece, prevented from turning by a loose fitting dowel, and outside this are three concentric tubes having a clearance between them. This clearance fills up with oil and permits a certain amount of the vibration of the inner shell, at the same time restraining it. The shell, however, revolves about its axis of gravity instead of the geometric axis, and the journal is permitted to run slightly eccentric, according as the shells may be out of balance, and thus vibration is prevented. Power is transmitted through the flexible coupling at R, and to this is attached a worm which drives a wheel for operating the oil pumps and the governor gear. The oil drains into the reservoir M, then into the pump N, whence it is raised to the tank O, where it forms a

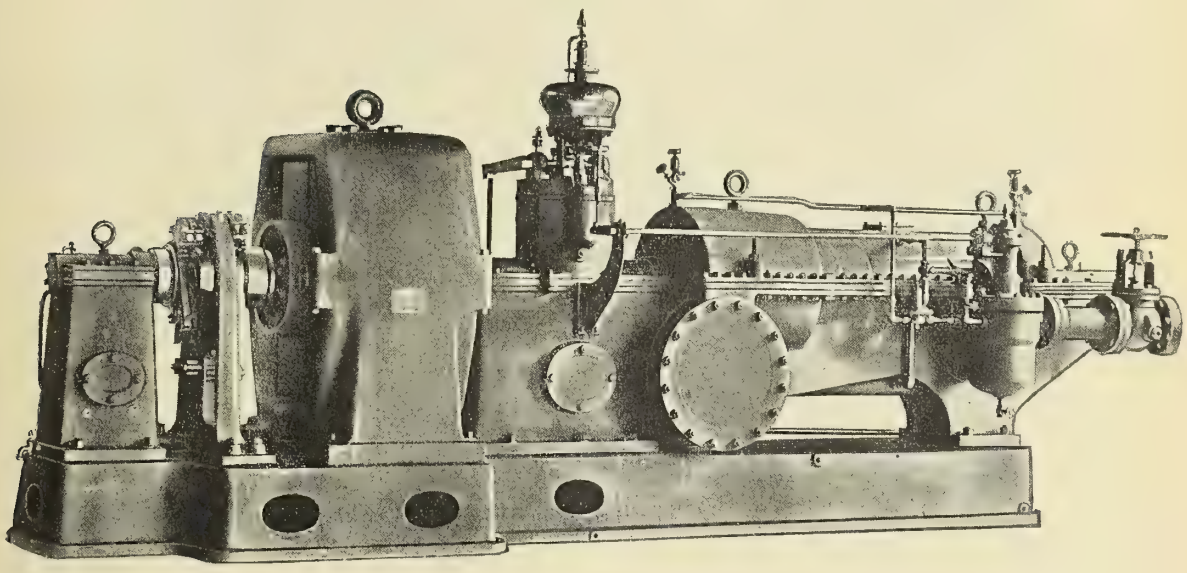
static head, giving a continuous pressure of oil to all the bearings. There is a by-pass at *P* which admits high pressure steam through port *Q* to steam space *E* By opening this valve as much as 60 per cent overload may be obtained.

of the turbine may be varied within all the limits of the governor spring while the turbine is running.

A test of a 300 kilowatt machine, one of the four now in operation at the Westinghouse Air Brake Compan's works, gave the following results:—



LONGITUDINAL SECTION THROUGH WESTINGHOUSE-PARSONS STEAM TURBINE.



500 HORSE POWER WESTINGHOUSE-PARSONS TURBINE DIRECT CONNECTED TO GENERATOR.
TOTAL WEIGHT, 25,000 POUNDS.

A fly-ball governor is made use of, and the ball levers are swung on knife edges in lieu of pins. The governor works both ways, namely, at the mid-position of the levers a full head of steam is admitted to the turbine, and the movement from this in either direction tends to close the throttle—that is, the turbine will be shut down in case of no load, or, for excessive overload, such as a short circuit. The speed

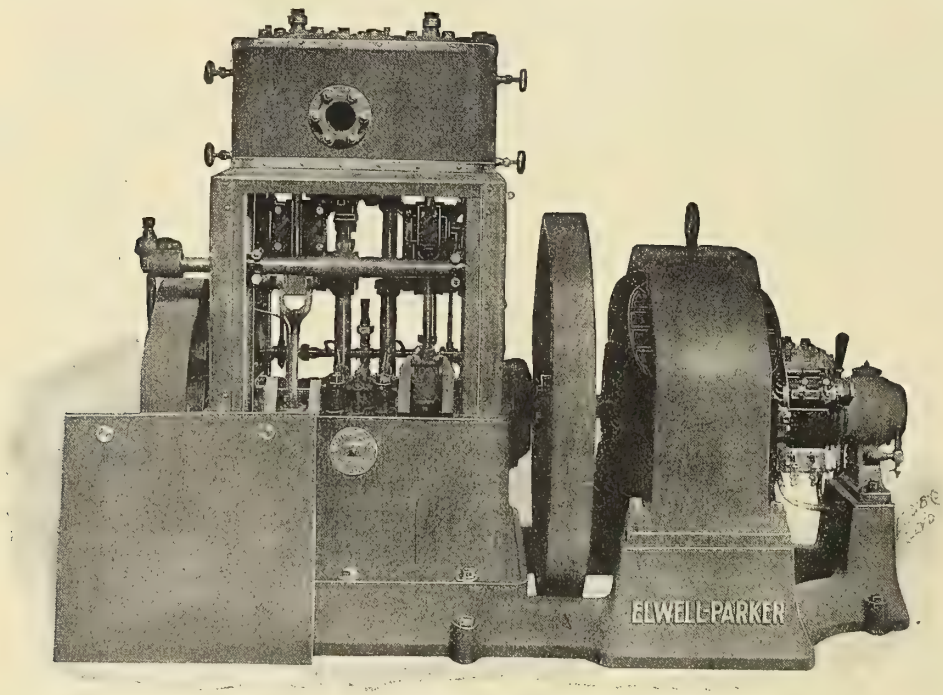
Full load, 16.4 lbs. steam per E. H. P. hour.
3-4 " 17 " " " " "
1-2 " 18.2 " " " " "
1-4 " 22 " " " " "
Running light, 750 lbs. per hour.
Vacuum, 26 inches to 27 inches.
Steam pressure, 125 lbs.
R. P. M. 3,600.

It will be noticed that these latter figures are per electrical horse power, thus giving results for steam in the output of the plant.

Many of these generators are now building, and it is stated that exceptionally good results are being obtained. Among the advantages to be noted are lightness, economy, capacity for overload, absence of fractional surfaces, freedom from vibration, slight cost of repairs, small floor space and automatic action and regulation. These features make the Westinghouse-Parsons turbine eminently suited to marine work.

Forbes High Speed Engine.

The illustration herewith presented is of one of the compound or double cylinder high speed engines, direct connected to a generator, and manufactured by W. D. Forbes and Company, of Hoboken, N. J. Like all engines of this class, the selection of material for the various parts is all important, and, in fact, where high revolutions are made, the workmanship must of necessity be unusually good, but one of the most important, if not the most important point of this class of engine, is to get the reciprocating parts very light and evenly balanced.



TWO CYLINDER HIGH SPEED ENGINE.

The designers of the engine illustrated have followed very closely recognized and well established designs. Search the engine from end to end, and it will be found entirely free from what are usually called "freaks," but the idea has been closely followed that wherever it was possible to remove a bolt or screw or pin from a moving to a stationary part, it was done. This is especially noticeable in the crosshead of the Forbes' engine. Here is simply one piece forged up, making the crosshead and piston rod one, the crosshead shoe being placed on the crosshead guides at the back, and the crosshead brass, a wedge, and one adjusting screw are all the parts that go to make up this important portion of the engine. Again, the connecting rod is forged of especially strong steel, and designed so that the crank brasses are shells which are comparatively inexpensive, readily fitted, and, of course, very much lighter than the usual stub end. As stated, the general make up of the engine is on recognized and approved lines, but the details are carried out in rather unusual ways. The governing of these engines is obtained by the use of the Rites' Governor, which has been adopted by some sixty odd engine builders in the United States alone. The simplicity of the design which W. D. Forbes and Company have gotten up for these governors is such that the entire governing is done by practically two pieces; that is to say, the standing arm and weight, a spring of course having to be used. The wearing parts of the governor are the bushes which fit the suspension pin and the governor pin, and these are of the very simplest construction, and can be made by any machine shop in a comparatively short space of time. Piston valves are used generally on both high and low pressure cylinders, when compounds are made, but the United States navy service demands a slide valve on the low pressure cylinder, and this style is also made. Metallic packing is used on piston rods and valve stems.

One of the most important points of any high speed engine is the oiling system. On double and compound engines the system of forced lubrication is used. This is obtained by means of a single acting pump, and the oil goes to all main bearings, crosshead and crank pin, under a pressure which can be adjusted at will and which has proved highly satisfactory. This system, of course, demands an enclosed case, which rather detracts from the general appearance of an engine, but this is entirely offset by the great advantages gained

by the use of a forced system. On single engines, a sight feed to the various bearings is used and is highly satisfactory, provided reasonable care can be given to the engines. When specially ordered these single cylinder engines are fitted up with forced lubricators.

The weight for the mechanical output on these engines is comparatively small; in fact, it is as light as any commercial engine regularly manufactured, and yet there is no sacrifice in strength. This has been accomplished through a judicious selection of material, together with good workmanship.

Some phenomenal long runs have been reported by these engines, one being over 135 days without stopping. The manufacturers believe that this would not be practical, unless the oiling system was of a forced kind, or unless the engine was lightly loaded; in fact, they lay great stress on this well known idea of ample lubrication.

ENGINEERING SPECIALTIES.

An Intercommunicating Telephone System.

There are two distinct types of interior telephone systems. The first involves the use of a central office, from which a line runs to each instrument. This necessitates of course a switchboard and operator. The second is an "intercommunicating" or "house" system, in which the instrument at each station is placed on a separate line, each line passing through

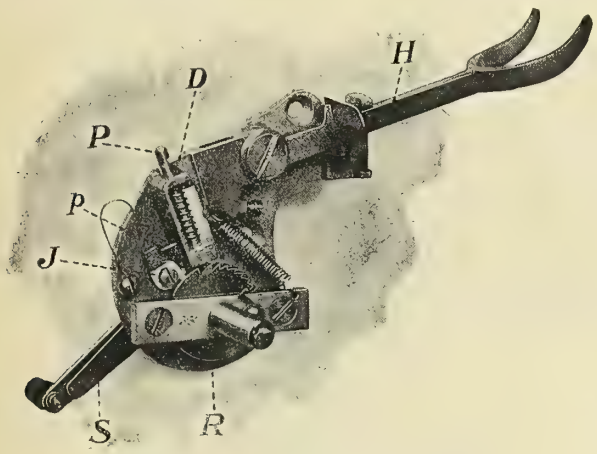


FIG. 1.

all the others instead of through a centrally located switchboard. By means of a simple switching device, the person at any station may connect his instrument with any other station without the intervention of an operator, thus saving the expense of switchboard and other central office equipment, the salary of the operator, and an expert to keep in working order the switchboard and accessory apparatus.

The Ness Automatic Intercommunicating Telephone System, which is manufactured by the Holtzer-Cabot Electric Company, of Boston, Mass., is the best known of the intercommunicating type. The automatic switching device, which is the distinctive feature of this system, is shown in Fig. 1, in which S is the lever of the selective switch, adapted to be rotated over the various contact buttons 1, 2, 3, 4, etc. It is held in any position to which it has been rotated by means of the ratchet wheel R, which is engaged by a pawl P. Upon the short arm of the hook lever, which forms the normal support of the receiver, is pivoted a dog, D, adapted, when the receiver is replaced upon the hook, to engage a notch in the pawl P and lift it out of engagement with the ratchet wheel. This allows a spiral spring to return the switch lever S to its right hand position in contact with the home button. After raising the pawl out of the notch on the ratchet wheel the dog slips out of the notch on the pawl, thus allowing the latter to return into contact with the ratchet wheel in order to be ready for the next use of the telephone. In order, however, that the pawl may not engage the ratchet before the lever S has fully returned to its normal position, a second dog, J, is provided, controlled by a spring so

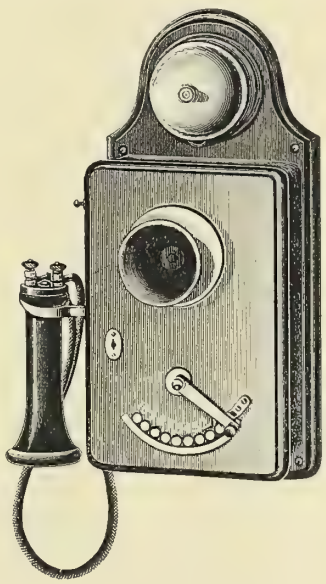


FIG. 2.

as to occupy a position under the pin P, carried on the pawl, thus holding it out of engagement with the ratchet wheel until the rotation of the lever is completed. At this point a cam, on the under side of the ratchet wheel, pushes the dog J out of engagement with the pin P, and thus allows the pawl to drop into position against the ratchet wheel.

This instrument is used in the following manner: rotate the switch arm shown in Fig. 2 until it rests upon the contact whose number corresponds to the station desired, when a slight pressure upon the handle signals the station required without interfering with any of the others. After having finished a conversation, the act of hanging up the receiver automatically restores the switch arm to its normal position, thus preventing an absent minded user from throwing the system into confusion by forgetting to return the switch arm to its home point. This overcomes one of the greatest objections to systems of this kind. Fig. 2 shows a 10 point Ness automatic switch telephone equipped with a standard bipolar receiver and gran-

ular carbon transmitter. This is known as the wall type and may be arranged for use with battery or magnetic call and with centralized or local talking battery, a backboard and battery box being fitted to the 'phone when the latter method is used. The bell, or buzzer, whichever the case may be, may be located either in or outside of the box. Another form of desk set is also made.

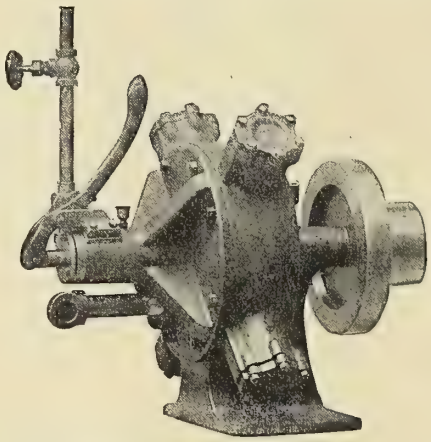
There are many instances in which it is not necessary for the different stations to signal each other, but simply to converse with the central point. In cases like these it is only necessary to have one automatic instrument, the others being single point telephones. Such an instrument as this has been designed especially for use in hotels, large passenger boats or between the various portions of an estate. These instruments are made as carefully as if they were to serve on long distance lines, all parts that are subject to wear being of hardened Stubb steel. The woodwork is of quarter-sawed oak, the trimmings nickel plated, making an ornamental instrument. The more important advantages of the Ness Intercommunicating System are the following: All departments have means of immediate communication with the head office, with the stock room, shipping department and with each other; it is not necessary for the foreman to leave his room or even his desk, and the general manager can easily inform himself of the affairs in all parts of the establishment with small expenditure of time and energy; several conversations may take place at the same time, thus in a 10 point installation five conversations may take place at once without interrupting one another. In short, whatever frequent and immediate communication is desired between any number of points here will be found the sphere of the Ness System of Interior Telephones.

Four Cylinder Engine.

The illustration shown represents an improved steam or compressed air engine designed to meet certain requirements where high speed and light powers are an advantage, such as detached machinery, pumps, dynamos, fans, farm and dairy machinery, etc. It is also particularly adapted to launches and small vessels of every description and locomobiles, owing to its compactness and strength in design of frame, and to the fact that no working parts are exposed to gather dust and dirt.

The most important feature of this engine is its simplicity, which will be apparent to all users of engines, as there are very few parts, all of which are easy of access. There are only two places that require packing. Fig. 1 shows the complete engine as used for stationary purposes. It will be seen that the frame, cylinders and bearings are all cast in one piece. There are four cylinders, single acting, set at right angles to the crank shaft, which is made of one solid piece of steel. The general operation will be sufficiently apparent from the figure.

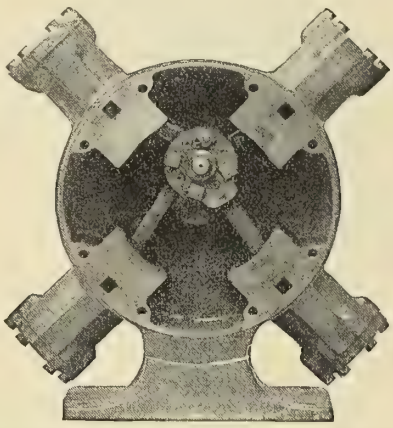
The valve gear is of the rotary type and very simple. It is operated by a disk and is controlled by a lever having a ratchet stop. By this arrangement the motion of the crank shaft can be reversed from right to left, speed slowed down or stopped. By this movement also a variable cut off is obtained, which is, of course, a great advantage for use on launches and locomobiles. In this manner the engine is always under the complete control of the operator. The operation is as follows: Steam is admitted to the side of valve frame, passing through ports in valve to the



LEONARD FOUR CYLINDER ENGINE.

tops of the cylinder and is exhausted back through the same valve to an exhaust chamber in the valve casing, and thence to the exhaust pipe.

All wearing parts are bronze bushed, and can easily be replaced. No attention is required to run the engine other than to keep the oil cups filled. There are no rods to key up or knocking of moving parts inside the casing, as in most engines of this class; and a most interesting feature is that it starts at once and at any point, either right or left, at the will of the operator. It is compact, strong and light of weight compared with the small upright engines on the market.



LEONARD ENGINE WITH VALVE CASING REMOVED.

The sole agent for this Leonard High Speed Engine is Joseph E. Wise, whose address is, Machinery Department, The Bourse, Philadelphia, Pa.

Sinking of the Walla Walla.

No case of collision at sea, involving the loss of one of the colliding vessels and the lives of 39 members of her crew and occupants of cabin and steerage, has created as much interest among seafaring men as that which caused the sinking on the Pacific Coast Steamship Company's steamer *Walla Walla* by the French bark *Max*. The sad accident occurred off the California coast on the morning of January 2d at about 4.35 o'clock, when the ships were five miles north and eleven miles west of Cape Mendocino light. The investigation into the cause of the disaster will determine whether either of the colliding vessels was observing the rules of the road at sea. The declarations by both the captain of the *Walla Walla* and the captain of the French bark, in each of which charges are made against the other of criminal neglect in handling the respective vessels, have drawn keen public attention to the pending verdict of the United States inspectors of hulls and boilers.

BARK MARX AFTER COLLIDING WITH AND SINKING THE WALLA WALLA.

The steamship *Walla Walla*, commanded by Captain A. L. Hall, left San Francisco for Puget Sound ports on the afternoon of January 1st. She carried 64 passengers and a crew of 80 men and officers. The bark *Max* was commanded by Captain Robert Benoist and 29 sub-officers and men. At the time of the collision she was 117 days out from Havre, France, her home port, in ballast for San Francisco, and her skipper was congratulating himself on the splendid time his ship had made around the Horn to the coast. The vessel was on the port tack and standing in toward the Mendocino light, which was plainly visible 11 miles away, when the crash came. The prow of the sailing vessel struck the port side of the steamer abreast of the pilot house. The bark was making two knots speed at the time of the collision and the steamer about nine knots. The force of the impact was increased rather than diminished by the *Walla Walla* sheering somewhat to port at the moment of coming together, with the apparent intention of swinging astern of the bark.

Many different statements have been offered regarding the length of time the *Walla Walla* remained afloat after the collision. Captain Hall stated in the report to his company that the vessel was above water 35 minutes. His estimate is offset by those of half a dozen members of the crew, including the first and second officers, who say that the steamer did not sink for 1 hour and 10 minutes. Quite a number of the rescued passengers concur in this estimate and it has been generally accepted.

After the collision occurred the *Max* drifted slowly away from the *Walla Walla*, but could not be brought about, as her captain feared that he was hurt hard and that the close proximity of a rocky beach would prevent his working his ship in her disabled condition. No boats were lowered from the sailing vessel, but she burned signal lights for some time after the accident, and her commander claims that he returned to the spot where the collision took place just as soon as he was able to work his ship. By that time the steamer had gone down and her boats and rafts with survivors had drifted miles to the northward. From the *Walla Walla* eight boats and four rafts were lowered. Some of these came ashore at Trinidad, on the north coast of California, and while attempting to

land in the surf seven people of one of the craft lost their lives. During the voyage of some of the other boats to different points along the coast, and before the rafts and remainder of the fleet were picked up by the steamers *Despatch* and *Nome City*, a dozen more people perished from exposure, or because of the repeated capsizing of the rafts. The balance of the 43 missing souls that sailed with the ill-fated steamer must have gone down with the ship or have been drowned on jumping overboard from the decks in an endeavor to reach the life-saving craft.

The statement of Captain Hall of the *Walla Walla* contained comparatively little of technical value, inasmuch as he was unable to relate the exact nature of the damage done the steamship beyond the fact that she was struck, as described heretofore, abreast the pilot house. The force of the blow was sufficient to carry the stem of the sailing vessel into the hull of the steamer as far as the center of the captains' cabin. Captain Hall said:

"I had gone to bed at 4.10 A. M., just after rounding the Cape. I changed the course of the ship. I was sitting in my cabin preparing to go to bed when—at about 4.30 o'clock—the whole side of my cabin was suddenly smashed in and something crushed me against my bunk. The pressure was soon released and clearing myself of the wreckage I went on deck and ordered the crew to launch the lifeboats and rafts. The bark was near by, but I did not see any lights. I could not tell the extent of the damage, but knew that we were hit hard, for the water was rushing in the break with a strange sound and the ship took on a considerable list to port and went down by the head. I remained on deck until the ship went down under me, attending to the lowering of the boats and maintaining discipline among the crew and passengers. The downward plunge of the vessel was by the head and to port; she simply slid under at an angle of forty degrees and I was carried with her by the suction.

"While under water I bumped against something, which proved afterwards to be a portion of the pilot house. With desperation I clung to the wreckage and managed on coming to the top to climb upon it. I remained on this raft until 3 o'clock in the afternoon, when the steamer *Despatch* sighted me and I was taken on board and carried to Eureka with other survivors who had been rescued by that vessel."

The first witness called by the United States Inspectors of Hulls and Boilers was Captain Robert Benoist of the *Max*. In a preliminary statement he described the damage done his vessel as a result of the collision, and said that the forward watertight compartment of the vessel had saved her from sinking. The jibboom of the *Max*, which was of steel, was broken and twisted and the tip of it trailed in the water at the port side at about a right angle with the hull. There were four plates punctured and the stem was bent about four feet above the waterline. The hole at the waterline was awash, but the crew of the bark believed the vessel had been struck below the line and did not know just how much buoyancy would be lent by the compartment if the forward part of the craft filled.

Captain Benoist took the stand and made his statement in French to an interpreter. Translated, it read in substance:—

"I am the master of the French bark *Max*. On the morning of January 2d the mate was on watch at 3.45 o'clock. The weather was cloudy, but there was no fog. A rough sea was running and the wind was from the south, veering to southeast, and the course was north 77 east (French computation). The mate came to tell me that he could see the Mendocino light at south 78 east of the compass. The lights of the steamer could be seen at 45 degrees off the starboard bow, but they were clouded at times by her own smoke. The sailor on the lookout reported to the mate and at that moment I came on deck and saw the lights myself and went to the poop and saw the steamer on our starboard side.

"When we struck I ordered a torch to be lighted and the foghorn blown. I could see the steamer fifteen minutes after the collision, and as soon as possible returned to the scene of the wreck and stayed there until noon of the next day. Seeing that our damage was in the forepart of the watertight compartment, I ordered this reinforced and did everything I could to prevent the ship from sinking."

By Inspector Bulger:

"Was anything done on the bark to avoid a collision?"

A. The ship was staying by the wind. After the collision occurred I had her brought about and laid to. We heard no hail from the steamer's crew.

Q. How far apart were the vessels when you first saw the lights?

A. I cannot say, but I think three or four miles.

Q. After the collision did you know that you had cut the steamer down to the water?

A. Yes, sir.

Q. Why didn't you launch a boat?

A. I was too busy with my own ship.

Q. Why didn't you hold to when you found that you had struck the steamer?

A. I did not know that she was so badly damaged. Our forepeak was full of water, but abaft there was very little water. We pumped it out by using the donkey engine. My own ship did not steer well after the collision. I steered toward the Mendocino light with the intention of coming about.

By Captain Hall:—

Q. Did you send anyone aloft at daylight to see if there were persons in the water?

A. Yes, sir.

By Second Officer Lupp, who was permitted to put questions, as he was considered the officer on trial:—

Q. What time did you place your lights?

A. At sunset.

Testimony was given by members of the crew of both the *Walla Walla* and the *Max*, but did not elicit anything conflicting with the testimony of the masters of the respective vessels.

Captain Hall was recalled to the stand on January 10, and in answer to questions by Inspector Bolles testified explicitly to the effect that before going to bed at 4 A. M. he saw no lights except that at Cape Mendocino. Just before turning in he went up on the bridge and noticed that the sky was overcast.

Charles Brown, Third Assistant Engineer of the steamer, was called. He said: "I was asleep at the time of the collision. The jar awoke me and I went on deck. I saw a big hole at the No. 2 hatch and saw a sailing vessel off a short distance. I then went down into the engine room and found no water there. Then going to No. 1 hold I made an investigation to see whether it were possible to shift the cargo from port to starboard to see if the hole in the ship could not be lifted out of the water, but as there seemed to be no hope I returned to the deck and helped get out the boats."

Peter Nelson, first officer of the *Walla Walla*, was sworn and said:—

"I was in bed and asleep at the time of the collision and went on deck as soon as I heard the crash. I saw a big hole in the *Walla Walla's* side and noticed the water rushing into the ship. I ordered the crew to their posts and helped lower the boats. I noticed a flare of light astern. I ordered boat No. 7 to proceed to the light, land the passengers and come back to the ship. We were endeavoring to get out boats Nos. 9 and 10 when the ship went down under us. I went down with her, but came up and was rescued by persons on a liferaft."

Correspondence.

INFORMATION WANTED ON A PRACTICAL POINT.

Editor of MARINE ENGINEERING:

Sir: I should like to inquire through the columns of MARINE ENGINEERING how I could stop the rumbling noise that steam makes when turned into the water heater. I know that there are arrangements which I could buy, but I should like to learn of something that I could make myself on board ship.

Respectfully,

L. J. P.

BOOK REVIEWS.

The Record of American and Foreign Shipping, 1902. Published by the American Bureau of Shipping, 66-70 Beaver street, New York; 1272 pages.

This is the fourtieth annual issue of the registry and classification of ships published by the American Bureau of Shipping, formerly the American Shipmasters' Association of New York. The Record contains full reports and particulars about vessels of all classes and nationalities, also rules for constructing and classifying vessels of steel, iron and wood and rules for constructing and surveying steam machinery and boilers for vessels, regulations for the installment of electric lighting and power apparatus on shipboard and other special information of importance to the shipping world. There are also included, lists of the addresses of prominent shipyards, dry docks, marine railways, engine and boiler builders throughout the United States, a list of vessels whose names have been changed and compound names indexed by the last name, lists of surveyors at the various ports with names and addresses of owners of vessels classified in the Record. One of the special features of this year's edition is that the tables of dimensions for constructing steel vessels have been brought up to include ships of the largest size. The work has been thoroughly revised and brought down to date.

Centrifugal Pumps, Turbines and Water Motors. By Chas. H. Innes, lecturer on engineering, Rutherford College, Newcastle-on-Tyne. Pp. VIII, + 296, with 239 figures in the text. Size 4 1-2 by 7 inches. The Technical Publishing Co., London. Price, 4 shillings 6 pence.

This book aims to place before the student in concise form the theory of turbines, centrifugal pumps and fans. The author develops his theory of the subject as an expression of the three fundamental principles—the law of conservation of energy, the law that the change of angular momentum is proportional to the angular impulse of the force producing it and the law or assumption that the losses of energy in a stream are proportional to the square of the velocity of flow. Based on this exposition of theory, the author then develops methods of design, both analytical and graphical, which should prove of practical service.

In addition to the discussion of theory and design the author gives a considerable amount of descriptive matter relating to the various types of turbine and centrifugal machinery found in practical use. The book contains also a descriptive chapter on the steam turbine, and chapters on the centrifugal and axial flow fans.

The theoretical matter is clearly put and does not attempt to go beyond that which is needed for the purpose which the author has in hand. The methods of design are clearly explained, and are put in such form as to be readily applied to actual problems. The illustrations are frequent and, for the most part, well chosen and executed. As a whole the book is a distinct and valuable addition to the literature of the subject, and should be of value to those interested in the design and operation of machinery of this class.

Power and Power Transmission, by E. W. Kerr, Asst. Professor of Mechanical Engineering, Agricultural and Mechanical College of Texas. Size, 5 1-2 x 9 inches. Pp. 356, with 264 figures in the text. New York, John Wiley & Sons. Price $2.

This book represents the substance of lectures delivered by the author to students of the elementary principles of engineering. Since the activities of the mechanical engineer are chiefly concerned either with the development of power or with its transmission to the point where it is to be used, the subject matter of the book may properly include nearly the whole field of mechanical engineering. Such is indeed the scope of the subject as treated by the author, and we have in this brief compass a discussion of the chief elements of general mechanical engineering in its various branches. The book is divided into three parts, the first covering the general subject of machinery and mechanics, the second that of steam power, and the third that of pumps, gas engines, water power, compressed air and miscellaneous topics. To cover this wide range of topics the author has naturally had to make selections among the vast amount of material available, and to present such parts as seem most important or best suited to the needs of the

student of the subject. On the whole these selections seem to have been made with care and good judgment. No two writers would, of course, agree in the selection of the material under these circumstances, but it can be fairly said that the student who is familiar with the topics here presented will have at least made a good start in the principles of mechanical engineering, will have become acquainted with many of its details, and will be well fited to go on into the specialties of the profession in such branch or branches as he may wish to pursue. The printing, binding and mechanical make-up of the book are in the well known and standard educational style of the publishers.

Marine Almanack, 1902. Edited by Mittheilungen aus dem Gebiete des Seewesens, Gerold & Co., Publishers, Vienna, Austria. Pocket size. Pages 582, with marginal index, blank sheets for notes, and pencil case, and many illustrations. Price, 4 1-2 marks.

This publication, which is yearly prepared under the immediate auspices of the Austrian Department of Marine, again comes to hand with its wealth of information on all points relating to the warships and navies of the world. While it is primarily intended for German speaking peoples, its accuracy, extent and variety of information and convenience in arrangement and size have justly extended its use as a convenient and compact source of information on the subjects of which it treats.

Aside from the calendar and other information of general interest, the subject matter proper is presented under five heads.

Part I. contains a collection of various tables of weights and measures with reduction tables for conversion from English to metric and vice versa. These tables will be of special value to the American or English reader as giving a ready means for converting into English measures the data given elsewhere in the book.

Part II. for the past two years has contained an admirable digest of international law, especially as related to naval warfare. In the present issue the place of this is taken by a digest of the laws and regulations relating to the naval personnel and to the administration of naval affairs generally. This section, while doubtless of interest to the Austrian naval officer or to the student of naval administration, has for the general reader hardly the value of the digest of international law which we have been accustomed to find at this point.

Part III. gives the usual tabular presentation of matter relating to naval ordnance.

Part IV. gives in the usual tabular form the leading characteristics and particulars of the various ships belonging to all naval powers. This covers 164 pages, and seems to have been prepared with the usual accuracy and care. This tabular matter is then followed by 141 pages of line drawings, showing the general appearance of leading and representative ships of the various navies, with diagrammatic representations of the character and distribution of the armor and main battery.

Part V. contains the Austrian Navy list, and has therefore but small interest for the general reader.

This little publication has justly gained an assured place in naval literature, and properly ranks high as an authoritative collection of data relating to the ships and naval ordnance of all naval powers, and may be cordially recommended to those who may wish to have at hand information on these subjects.

The Engineering Index for the years 1896-1900. Edited by Henry Harrison Supplee. Size, 6 by 9 inches. Pp. 1030. Published by the Engineering Magazine, New York. Price, $7.50.

Perhaps the most astonishing feature of the modern development in science and engineering is the prodigious extent of the literature published on the subject and the vast number of things which a man must remember about, or at least be able to promptly locate if he wishes to keep measurably well informed on the details of his profession. To this end the engineering index has become one of the necessities of the library or office shelves of the live engineer.

In 1884 the idea of an index of engineering periodicals was put into practical form by Professor J. B. Johnson, then professor of Civil Engineering at Washington University, St. Louis, Mo. This index was published in the Journal of the Association of Engineering Societies from 1884 to 1895. In the meantime, a somewhat similar movement having been undertaken by the Engineering Magazine, in 1895 the work carried on by Professor Johnson was relinquished in favor of the Engineering Magazine, which has carried it on to the present time. The breadth of the work thus carried on has constantly increased until at the present time it consists of a fully classified monthly index of the contents of nearly 200 technical journals published in the United States and Europe.

The purpose of the present volume is to gather under one cover the monthly indexes which have been published during the past five years, or for 1896-1900 inclusive. There have been two preceding volumes covering the years 1894-1891 and 1892-1895. The scope of the present volume may be inferred from the statement that it comprises some 40,000 entries drawn from about 200 sources, being about four times the number of entries per year found in the earlier volumes.

Each entry gives the title of the article, the author's name, a few lines descriptive of its scope or of the chief points, its approximate length in words, with the name and date of the periodical where published. Much of the value of such an index depends, of course, on the arrangement under classes, headings, catch words, etc. These features seem to have been given careful attention, and the system followed is fully explained in the introduction, so that any given topic may be found with the minimum of time and trouble. The work represented in the preparation of such a volume is, of course, enormous, but it is well that this has not deterred those having the matter in charge from carrying it on, and that, thanks to this combination of business enterprise and engineering skill, we have this valuable collection of references to the engineering literature of recent years. The volume may be most cordially recommended to all who are interested in keeping in touch with engineering progress, as shown by the current periodical literature of the subject.

Water Tube Boilers. By Leslie S. Robertson. Size 5 1-2 x 8 1-2 inches, pages 193, cuts 170. Price $3. New York: D. Van Nostrand and Co.

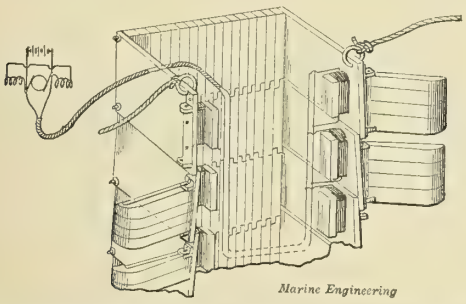
This book is based on a short course of five lectures which the author was invited to deliver at University College, London. There is no attempt in this book to cover the subject of water tube boilers with the same exhaustiveness of treatment as that found in the French work of M. Bertin, and which Mr. Robertson has translated into English. The present work does, however, contain a considerable amount of material which the author has drawn from this source. The main purpose of the author is rather to provide a descriptive book on the subject at moderate price, and to which students and practical engineers might refer. Chapter I. deals with the subject historically. Chapter II. discusses circulation, draft, combustion and a series of other topics relating generally to the operation of this type of boiler. Chapter III. takes up the modern boilers of the large tube type; Chapter IV. those of the small tube type, and Chapter V. the general subject of boiler accessories. In an appendix is given the now somewhat celebrated "interim" report of the Admiralty committee on water tube boilers.

In so far as the purpose of the author was to provide a descriptive and semi-popular work on this subject, he seems to have succeeded admirably. The subject is most fully illustrated and contains cuts of all manner of water tube boilers, those introduced in the early periods of development and only interesting from an historical standpoint, as well as those found more or less commonly in present day practice.

The only question which may arise is perhaps as to the field of usefulness of a book containing so little beyond the purely descriptive. The student and the engineer are often interested in the descriptive, but it may be fairly questioned if the book would not have been enhanced in value by the omission of a part of the purely descriptive matter and the insertion of a somewhat fuller treatment of the subject of circulation and of other points of perhaps a somewhat greater practical present day importance. The book is well printed and bound, the illustrations are for the most part well executed, and the book will have its value for all who are interested in the water tube boiler as the coming steam generator for marine purposes.

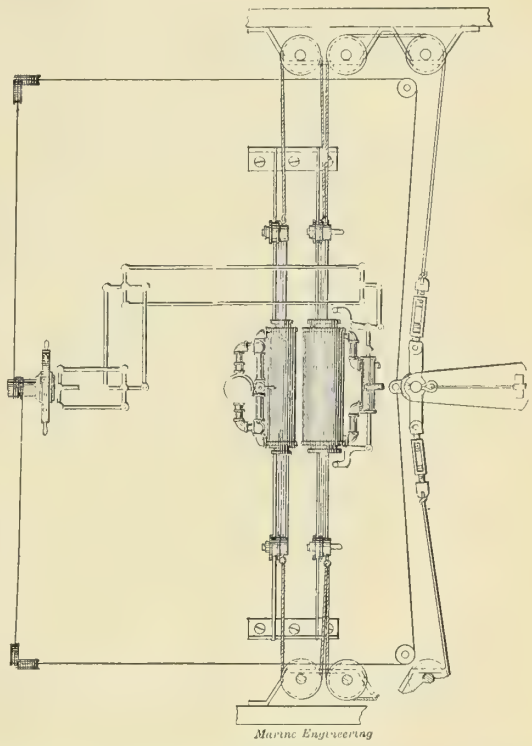
SELECTED MARINE PATENTS.

689,970. CAISSON FOR REPAIRING VESSELS AND SUBMERGED SURFACES. DAVID MASON, NEW YORK, N. Y.



CLAIM.—Means for repairing and inspecting the sides and bottom of a floating vessel consisting of a flexible vertebrated water tight caisson made up of separable sections, the outer surface of which consists of a series of blocks joined together by bolts extending laterally through them, the lateral sides of the caisson being composed of overlapping steel plates secured by the same bolts which hold the separable sections together; in combination with means for causing said flexible caisson to adhere to the side or bottom of the vessel when properly located in position, substantially as described.

689,145. ENGINE FOR STEERING VESSELS. FRANK B. TURNER, VANCOUVER, CANADA.



CLAIM.—In a steam steering gear, the combination with the parallelly disposed steam and oil cylinders, the piston rods which are adapted to connect with the tiller of a ship; of a valve mechanism disposed between and having communication with the opposite ends of the steam cylinder, lever devices connected to the opposite piston ends of the said valve, and devices on the opposite ends of the piston rod of the steam cylinder for engaging the said lever devices, for the purposes described.

689,648. SAIL. GEORGE A. LOWRY, CHICAGO, ILL.

CLAIM.—A sail composed of independent sections, each section separated from but overlapping the next adjacent section, whereby each section spills the wind away from the other or adjacent sections, as and for the purpose set forth.

2. A sail composed of independent sections of increasing width from one end to the other thereof, said sections overlapping each other at their widest ends, but separated from each other.

689,782. VESSEL. WILLIAM BLANCHARD, SCRANTON, MISS.

CLAIM.—In a vessel, a hull having an outer and an inner sheathing spaced from each other, said inner sheathing forming a storage reservoir, a cover for the reservoir, a deck located above the reservoir and spaced therefrom, forming an intermediate chamber, and open-ended tubes extended across the space between the inner and outer sheathings and communicating with the intermediate chamber and the exterior of the vessel.

689,784. STOP MECHANISM FOR ENGINES. WILLIAM F. BRADBURY, KANSAS CITY, KANS., AND DIXON E. WASHINGTON, KANSAS CITY, MO.

689,821. HULL CONSTRUCTION. CHARLES H. HOWLAND-SHERMAN, WASHINGTON, D. C.

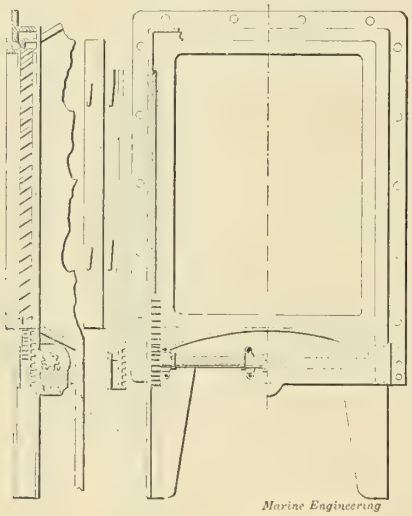
CLAIM.—Combined in a hull structure, a keel proper having a central, superior longitudinal channel and longitudinal enlargements along its sides; and a web-keelson centrally attached thereto; the construction being such that both the said web-keelson and keel enlargements are adapted for attachment to the contiguous parts of the hull structure, substantially as described.

690,029. BOAT WILLIAM B. MOTHERAL, NORTH McGREGOR, IOWA., assignor of two-thirds to Charles Z. Pote, Washington, D. C., and John S. Rodgers, Charleroi, Pa.

CLAIM.—A boat having a bottom with a flat middle portion, and inclined portions on each side thereof of varying pitch, substantially as set forth.

2. A boat having a bottom with a narrow bow, and wide stern, formed with a central flat portion increasing in width from bow toward the stern, and inclined portions of varying pitch on each side of said flat portion also increasing in width from bow toward the stern, substantially as set forth.

690,032. SIDE LIGHT AND WINDOW FOR SHIPS. GAVIN C. RALSTON, LEWISHAM, ENGLAND, assignor to J. Stone and Company, Deptford, England.



CLAIM.—A sliding window sash guiding for reciprocating motions in the fixed frame, the latter provided with a rubber ring for the sash to make joint with, means for reciprocating the sash and for holding it stationary in the closed or partly closed position, and mechanism on the inclined plane principle for moving the sash toward the rubber ring and pressing it against the same, substantially as set forth.

2. A sliding window sash provided with slanting lugs, a tooth rack on each side provided with slanting surfaces between which the aforesaid lugs pass in the closing of the sash, a fixed frame provided with joint seating ring and wherein the sash and the racks are guided and wheel gearing on the fixed framework for moving the racks and the sash together therewith, and for finally pressing the sash horizontally against the joint seating substantially as set forth.

690,089. VESSEL UNLOADING APPARATUS. GEORGE P. WETMORE, SAN FRANCISCO, CAL.

CLAIM.—The combination with a barge or vessel, of a series of compartments, having discharge chutes with controlling gates, an endless traveling carrier located beneath and adapted to receive the discharge from either of the chutes, a framework with endless elevator, a drum and driving shaft about which the lower end of the elevator passes, supports axially in line with the driving shaft upon which the lower ends of the elevator frame are supported, and means for delivering the material from the carrier to the elevator.

690,215. RECREATION SUBMARINE BOAT OR BOAT VEHICLE. JOHN WILSON, PERTH AMBOY, N. J.

690,216. SCOW. CHARLES WINK, POMEROY, OHIO.

CLAIM.—In a scow or other vessel, means for securing the floor timbers to the hull, comprising a plate secured to the hull, a socket in the said plate adapted to receive the floor timbers, a key seat in the socket and a key in said key seat.

2. In a scow or other vessel, means for securing the floor timbers to the hull, comprising a plate secured to the hull, arms extending from said plate adapted to hold the floor timbers, a recess in said arms, and a key adapted to enter said recess.

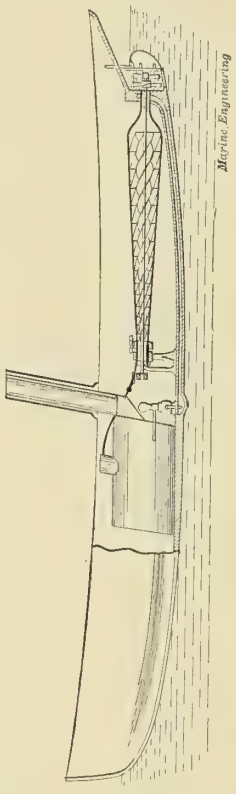
690,267. MEANS FOR PROPELLING VESSELS. ROBERT F. GILLIN, BROOKLYN, N. Y.

CLAIM.—The combination with a vessel of a cylinder of large cross sectional area arranged with its axis in a plane passing through the central longitudinal line of the vessel, having its forward end closed and its rear end open, and extending through the hull below the water line, an open branch pipe of smaller cross cestional area extending from the cylinder on each side near the forward end through the hull below the water line, approximately parallel with and in the same direction as said cylinder, the combined discharge capacities of said branch pipes being co-equal with the discharge capacity of said cylinder, a plunger in said cylinder, and means for reciprocating it therein, all substantially as and for the purpose herein specified.

690,685. LIFE BOAT. ALEPH ANREP, MOSCOW, RUSSIA.

CLAIM.—A life boat adapted to be launched from a vessel, having the lines of the deck and bottom at that end of the boat which is ahead in launching, forming with each other an acute angle, and having the lines of the deck and bottom at the other, or following end of the boat curved upward, whereby the boat is caused to dive through the water in a downwardly curved path, substantially as set forth.

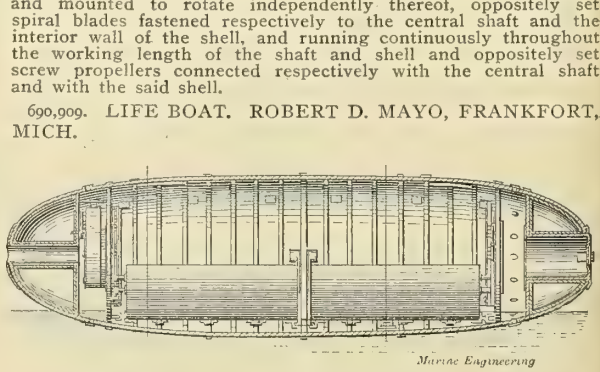
690,821. MARINE PROPULSION. JOHN J. ASTOR, NEW YORK.



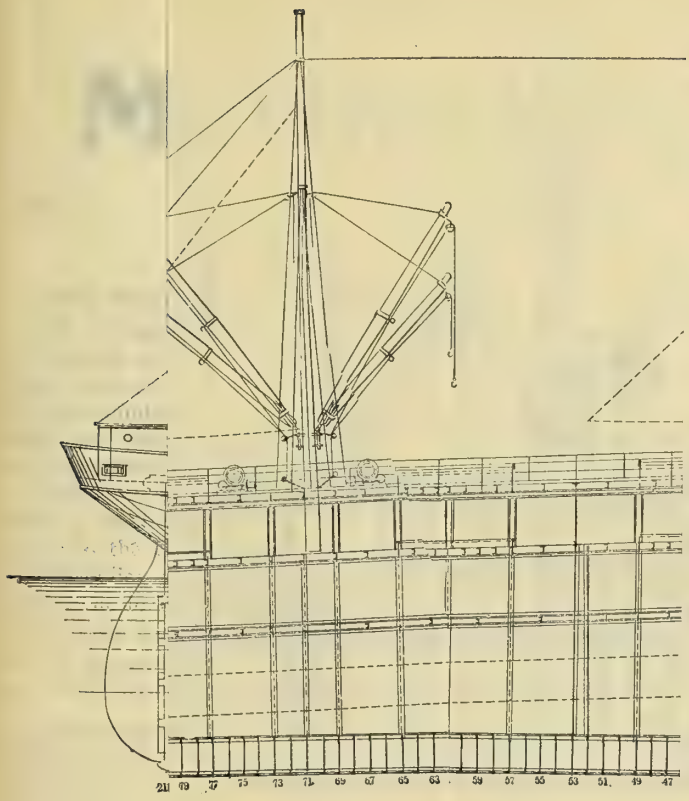
CLAIM.—In an apparatus for marine propulsion, the combination with a central rotative shaft, an exterior shell inclosing the shaft and mounted to rotate independently thereof, oppositely disposed spiral blades fastened respectively to the shaft and to the interior wall of the shell, the blade of the shell running across the blade of the shaft, and said blades having their adjacent edges abutting against each other, and oppositely set screw propellers connected respectively with the central shaft and with the said shell.

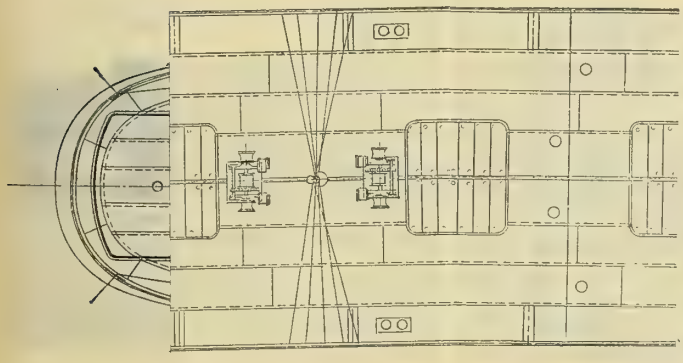
2. In an apparatus for marine propulsion, the combination of a central rotative shaft, and exterior shell inclosing the shaft and mounted to rotate independently thereof, oppositely set spiral blades fastened respectively to the central shaft and the interior wall of the shell, and running continuously throughout the working length of the shaft and shell and oppositely set screw propellers connected respectively with the central shaft and with the said shell.

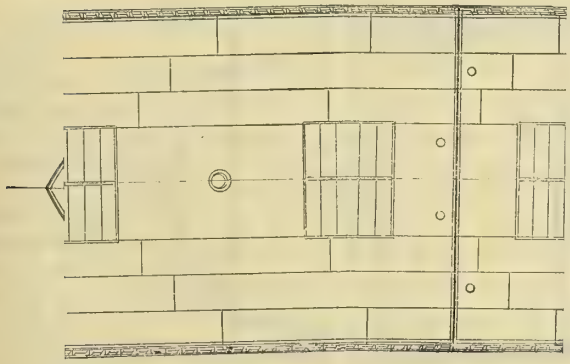
690,909. LIFE BOAT. ROBERT D. MAYO, FRANKFORT, MICH.



CLAIM.—In a life boat of the class described, the combination of an outer cylindrical inclosing shell, a transverse bulkhead arranged at or near each end thereof, between which is formed a living compartment, an oscillating carriage in such compartment, and chain mechanism secured to such oscillating carriage and movably mounted on the bulkhead at a point above the axial center thereof to permit independent oscillations of the carriage, substantially as described.







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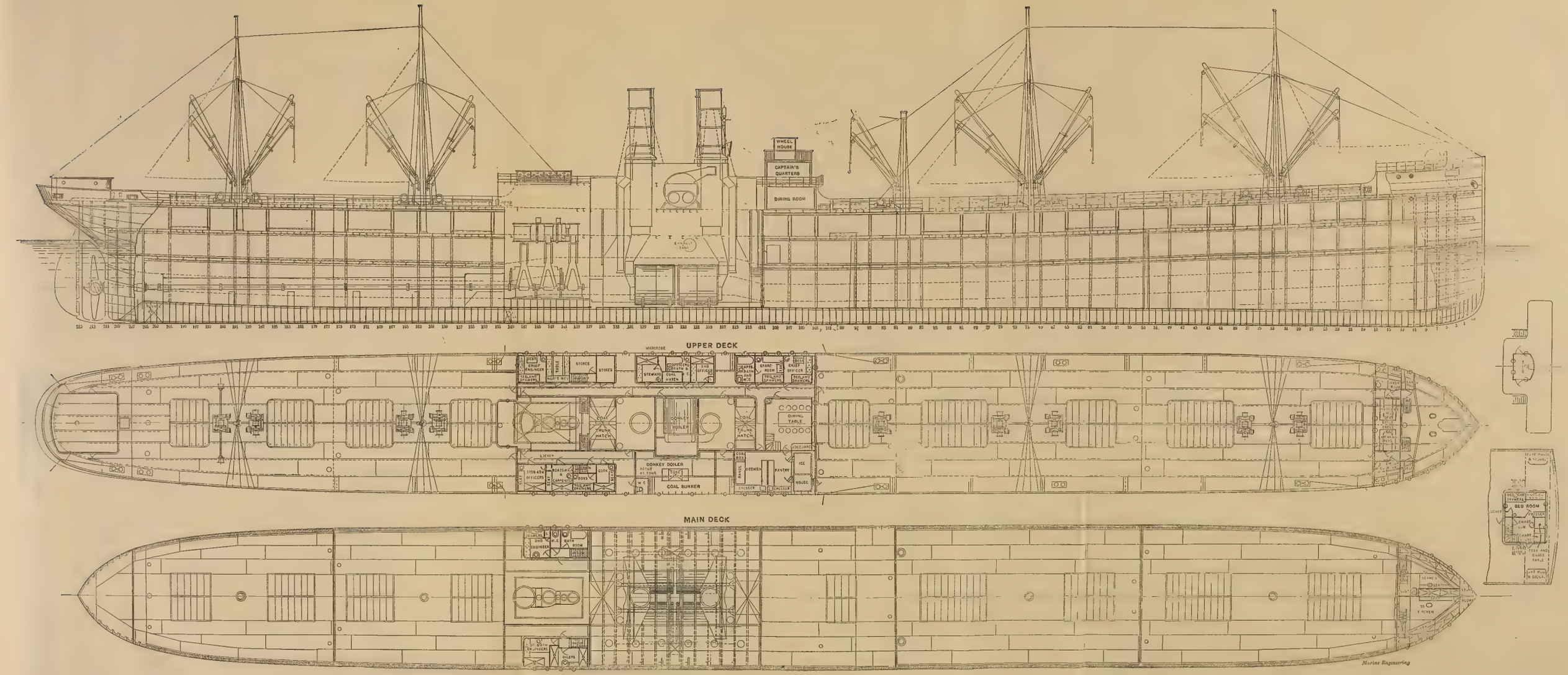
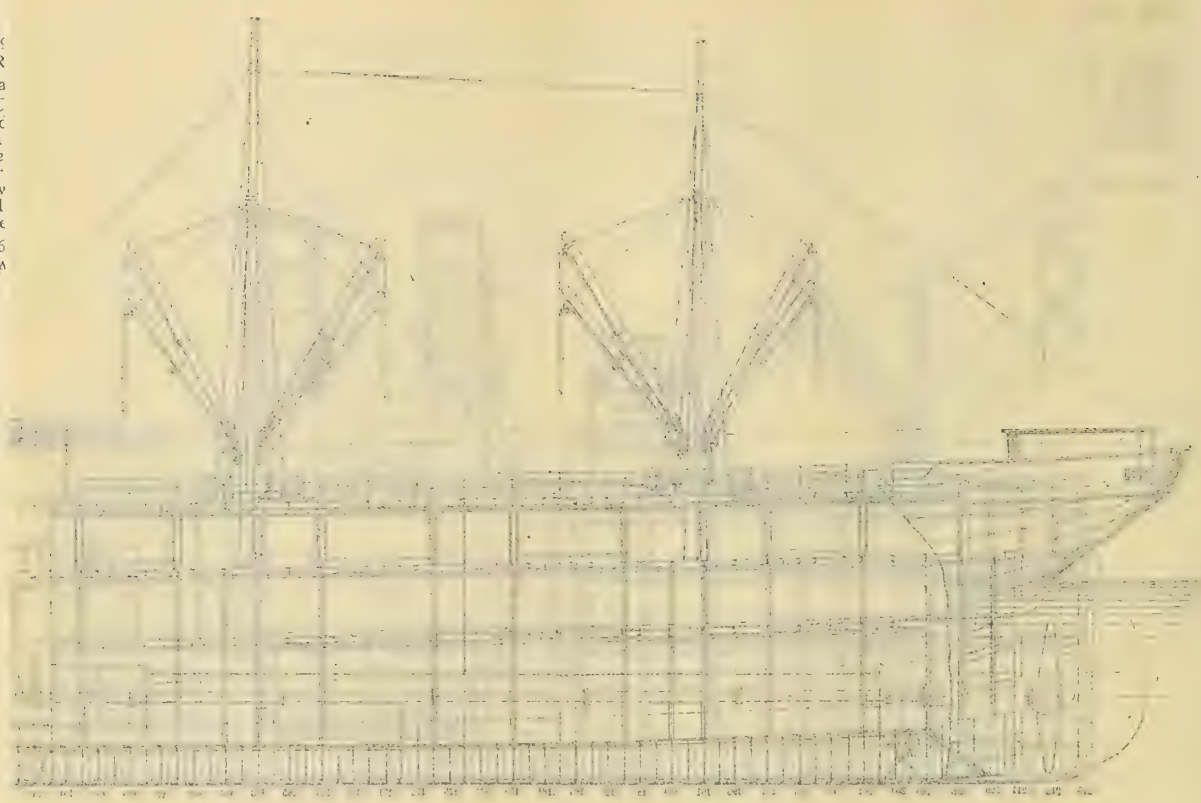
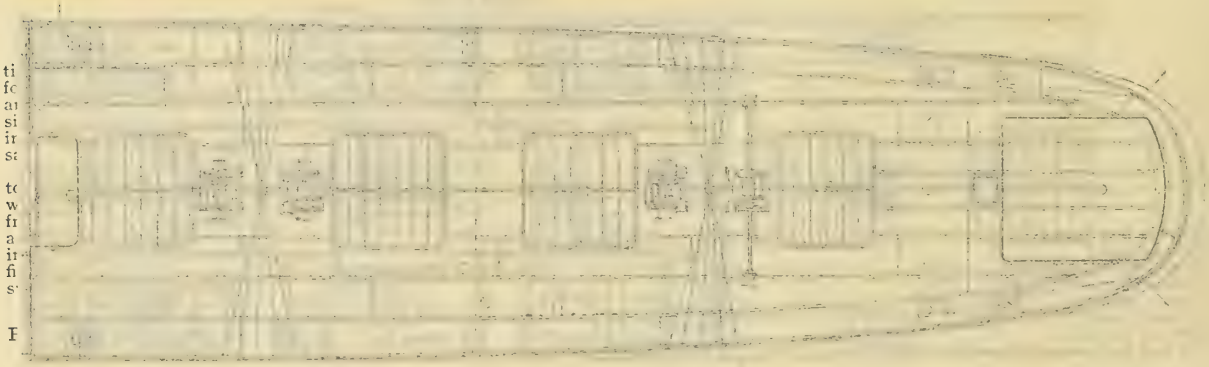
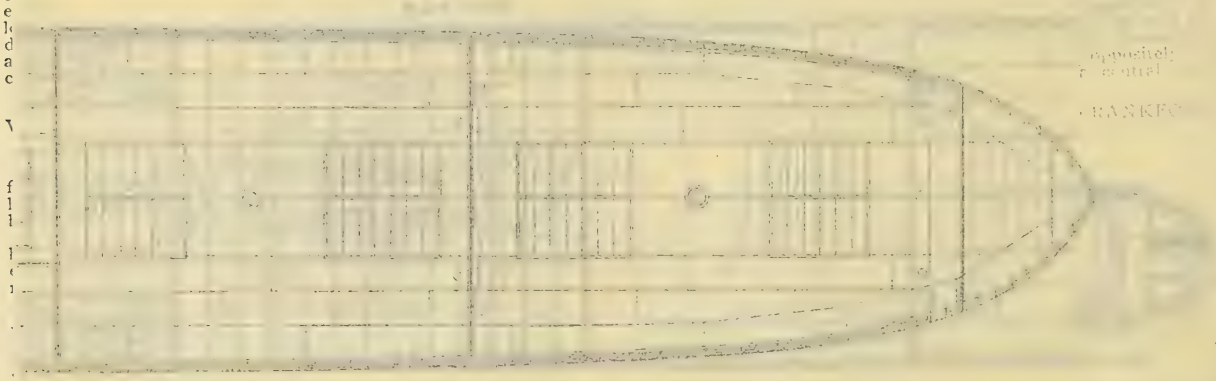


LONGITUDINAL AND DECK PLANS OF THE OCEAN FREIGHT STEAMERS MINNETONKA AND MINNEWASKA, BUILT AT THE CLEVELAND YARDS OF THE AMERICAN SHIPBUILDING CO. FOR THE AMERICAN NAVIGATION CO. OF NEW YORK.

FOR DESCRIPTION SEE PAGE 185.







LONGITUDINAL AND DECK PLANS OF THE OCEAN FREIGHT STEAMERS MINI

UNBOUND

Marine Engineering

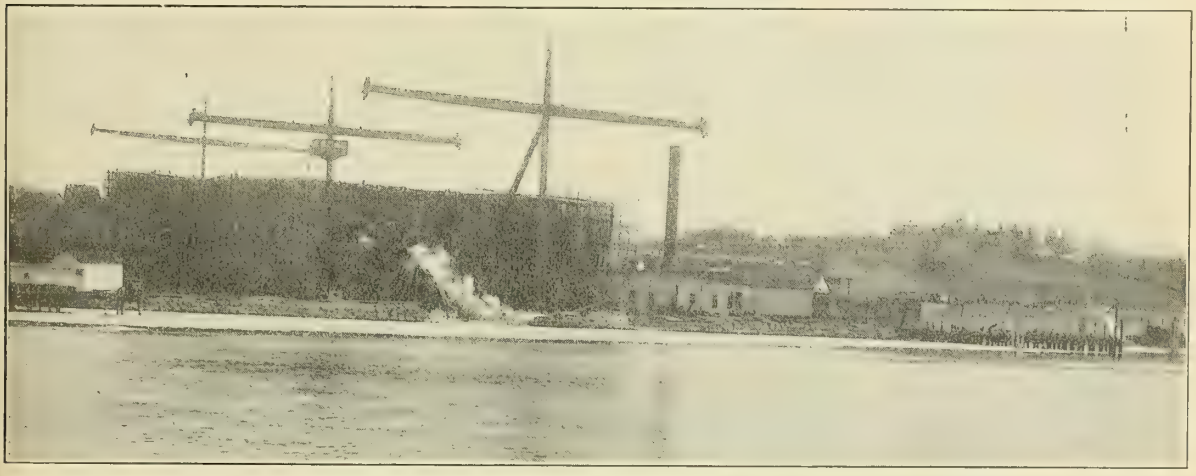
Vol. 7. NEW YORK, MARCH, 1902 No. 3

MAR 10 1902 PATENT OFFICE

THE EASTERN SHIPBUILDING COMPANY.

The closing years of the past century were made memorable in the annals of American industrial progress by an extraordinary increase in its business prosperity, stimulated, as it was to a great extent, by the wise and progressive policy of the general government and by demands growing out of the Spanish war.

Then came the disturbance in the East and its attending results in the rapid expansion of our commerce to the Orient. The outgrowth of the governmental policy of expansion and its accompanying improvement in its naval strength is found in the fact that several large establishments for the building of vessels have sprung up of late, and American shipping and shipbuilding has been given an impetus which



THE WORKS OF THE EASTERN SHIPBUILDING COMPANY FROM THE THAMES RIVER.

savors of dawning prosperity and a rapid increase in our commercial marine. Old shipbuilding establishments have found themselves congested with orders for either the government or private parties, and new plants have been erected at various points of commanding advantage, ready to take their share of the increased business. We are now at a period when our merchant marine must improve the opportunity and increase its transportation facilities.

Some of our great railway corporations immediately laid plains responding to the demands of a rapidly increasing business prosperity. They began seriously considering what must be done to protect their interests. It required but little time for these shrewd and far-seeing railroad managers to reach conclusions; they had been thoroughly schooled by an experience suited to the task. Among the first and most aggressive of these corporations to take action was the Great Northern Railway Company, of St. Paul, through its president, James J. Hill. Figuratively speaking, Mr. Hill is a man who "never slumbers nor sleeps," ever watchful, ever wakeful to the vital demands of his business interests.

In the natural course of business Mr. Hill had become acquainted with Mr. Hanscom, then general superintendent of the Bath Iron Works, Bath, Me. In Mr. Hanscom was found the man needed for the furtherance of these plans for increasing the transportation facilities of the Great Northern Railway Company, and in due time a contract was agreed upon for the construction of the two largest freight and passenger steamships ever built in the world, involving an expenditure of $5,000,000.

Then followed the organization of the Eastern Shipbuilding Company, consisting of Mr. C. W. Morse, of New York, Mr. Hanscom and a few other prominent business men, and the location of the present shipbuilding plant. Mr. Hanscom, together with the naval architect and engineer of the company, Mr. W. A. Fairburn, visited various localities along the Atlantic coast, and finally determined upon the present site of the Eastern Shipbuilding Company, at Groton, opposite New London, Conn., on the banks of the Thames. The site selected was formerly used by the New York and Providence Railroad as a ferry terminal before the drawbridge across the Thames was built.

In the summer of 1900 work was begun in laying out the yard, and at the same time temporary offices and a drafting room were secured. Plans were prepared for the monster vessels under contract, and the work pushed forward with dispatch. Contracts for material

(Copyright, 1901, by Marine Engineering, Inc., New York).

and supplies were placed at an early date and to an amount rarely heard of in shipbuilding. From this time on the work of building the plant and the ships has been carried on simultaneously.

The advantages of location are many and very important, among which may be noted the extensive water-front of over one-half mile, ample depth of water at all tides, direct railroad communication to all points east and west, pleasant, good working climate, and approximate nearness to markets for all classes of supplies.

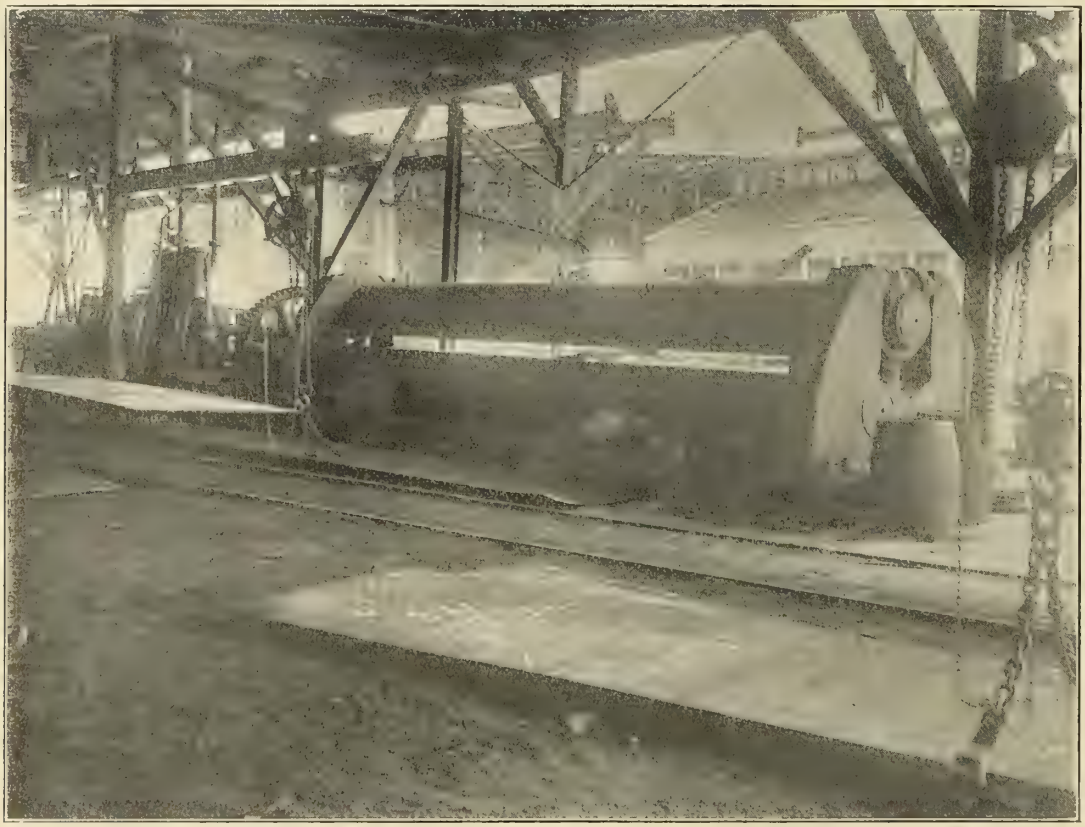
Entering the yard by the railroad track from the south, for over a thousand feet the land is used for storing material. The extent of space required will be realized by the fact that in the steel work of the two hulls now undergoing construction there are about 28,000 tons of steel.

The material is unloaded and stored by locomotive cranes having a sweep of 80 feet. The plates are then laid off from template, loaded upon cars by the cranes and run down the yard to the ship sheds.

As we proceed northward the first building to the right contains the carpenter and joinery shops, with a mold loft above. Farther on are the machine, pipe and sheet iron shops. Opposite to these buildings, on the banks of the river, is the plate shop. North of the plate shop are the engine and boiler rooms, bending slabs, furnaces and forges. Immediately beyond and extending across the yard in an east and west direction are the ship ways. The general layout of the yard is shown in the illustrations on pages 99 and 100 taken from recent photographs. Let us now inspect the various buildings above mentioned.

At the south end of the plate shop, and opening directly into it, is the new laying out shed of 100 by 60 feet, which is equipped throughout with jib cranes. The locomotive cranes can also enter this shop, and overhead is a heavily timbered storeroom for electrical equipment and electric workshop.

The punch shed, or plate shop, built of heavy timbers, is a well-lighted building, 300 feet long by 80 feet wide, and here are found the heaviest and largest machines used for plate and shape work. There are in all twenty-five large tools in this shed, arranged in three lines, and driven from one overhead main line of shafting running down the center of the shop. The tools for the angles are on the east or open side of the building, and include horizontal punches, angle shears, etc. In this line are also three sets of rolls. The largest set, which is run by a double steam engine, is built by Hilles and Jones, can handle 26-foot plate, and may also be used for flanging. This machine weighs 100 tons. Adjoining are the straightening rolls and the mast rolls, both of which are belt driven from the main shaft. The shears and punches down the center of the building are of the heaviest pattern, and most of them are built by the Hilles and Jones Company. The largest punch is of 60-inch throat, can punch a 2-inch hole through a 1 1-4 inch plate, and weighs 30 tons net. The capacity of this shop is 2,000 tons of steel machined in one month of ten-hour working days.



TWENTY-SIX FOOT BENDING ROLLS.

Along the rear of this shop are two pairs of double radial countersink drills made by the Prentiss Machine Company, a 30-foot planer of 25 tons weight for planing the edges of plates up to 1 3-8 inches, and a compound scarfing machine and butt planer, which was designed by the Eastern Shipbuilding Company and made by the Builders' Iron Foundry. This is a novel machine, and has proved very efficient in service. It has a capacity for planing the edges of steel plates 8 feet wide and 1 1-4 inches thick, and for milling two scarfs, 6 1-2 inches wide by 16 inches long, at the same time. The planing mechanism is of the usual type, the plate being clamped to the table by a series of jack screws bearing against a stiffed bow girder. The scarfing mechanism is of the milling machine type, and is made very heavy to avoid chattering. The spindles are 3 1-2 inches diameter and made of high grade open-hearth steel, carefully fitted to bronze line bearings, adjustable for wear. These spindles are not vertical, but are set perpendicular to the scarfed surfaces. The milling heads are clamped to the gun iron girder of the machine. Horizontal feed takes place at the ends where the housings are simultaneously moved by screws, which are positively driven from the same shaft that drives the spindles. The spindles are given a slow vertical feed, which combines with the horizontal feed in such a way as to result in a strictly diagonal movement at the desired angles. The total weight of

PLATE PLANER.

VIEW LOOKING INTO PLATE SHOP AND DOWN THE YARD—JOINER SHOP AND MOLD LOFT TO THE LEFT.

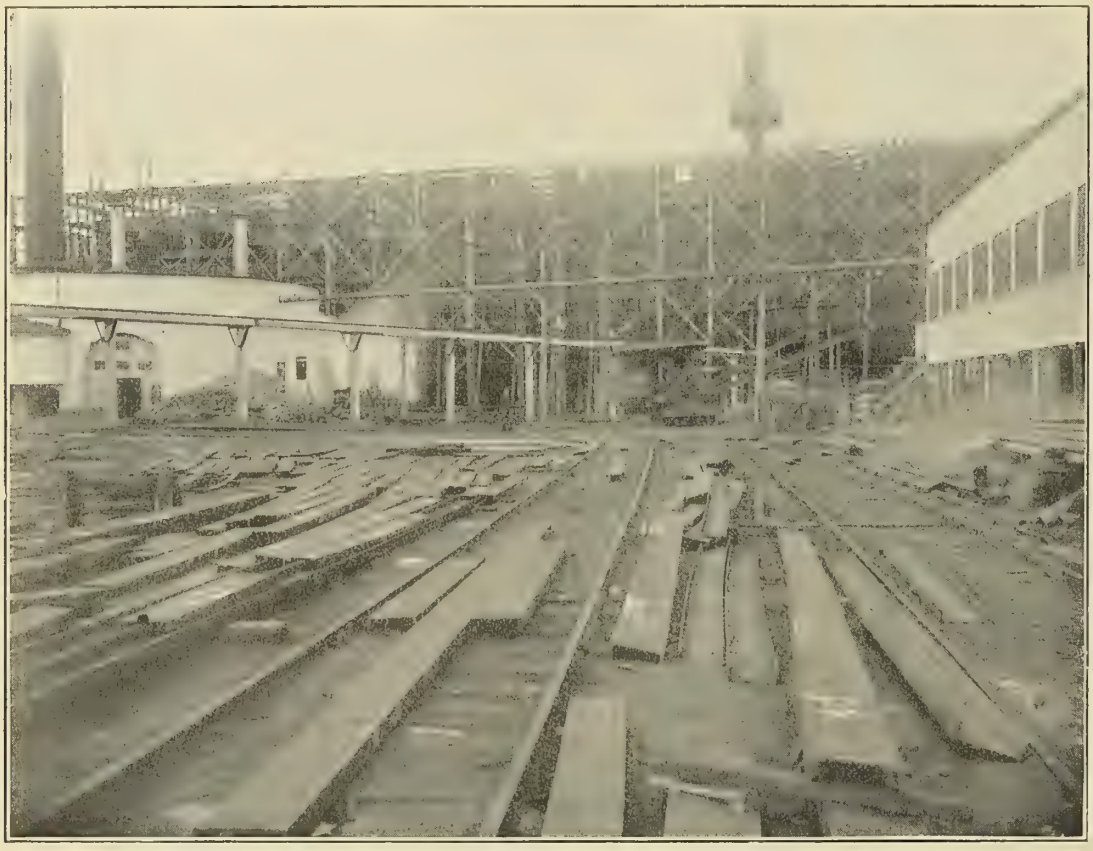
the machine is 9 tons, and it is well designed, with metal judiciously arranged to resist the stresses which are met with in machinery of this class.

Over each of the machines in this shop is a jib crane; those used for serving the countersinks and planers are of wood, with iron braces and stepped on the floor, but all the others are of steel stepped on the machines themselves and guyed from the girders in the roof trusses. These latter cranes are made of special section to meet the requirements of each machine. All the cranes are fitted with under-hoistings.

Adjoining the north end of the plate shed is the power house for driving the machinery and compressing the air for the pneumatic tools. An Erie engine of 175-horse power, running at 225 revolutions, drives the line shafting in the plate shed. There are two compound steam and air piston intake compressors built by the Ingersoll-Sargeant Company which have intercoolers and superheaters and deliver the air at 100 pounds pressure. The capacity of the small machine is about 1,500 cubic feet of free air per minute, and that of the larger machine about 2,000 cubic feeet. A Wheeler condenser with 3,000 square feet of tube cooling surface is mounted over a Blake compound air and circulating pump and receives the exhaust steam from the entire plant.

The compressed air from the compressors in the engine room is led to two vertical cylindrical receivers at the after end of the shipbuilding berths through an 8-inch pipe, and from here is distributed through several mains running the length of the berths. From these it is tapped into rubber hose leading to headers and then distributed to the different tools. Pneumatic riveting has been used almost exclusively in all ship construction work at this yard.

To the north of the engine house is a large brick building containing the bending slabs and furnaces, the blacksmith shop and the boiler house. The shapes may be drawn on skids to the bending floor from the angle shop by means of an electric winch. The maximum length of the bending slabs is 80 feet and the width 50 feet. There are two steel plate bricked furnaces, one of which will take a plate 30 feet by 8 feet, and the other will heat shapes up to 80 feet in length.

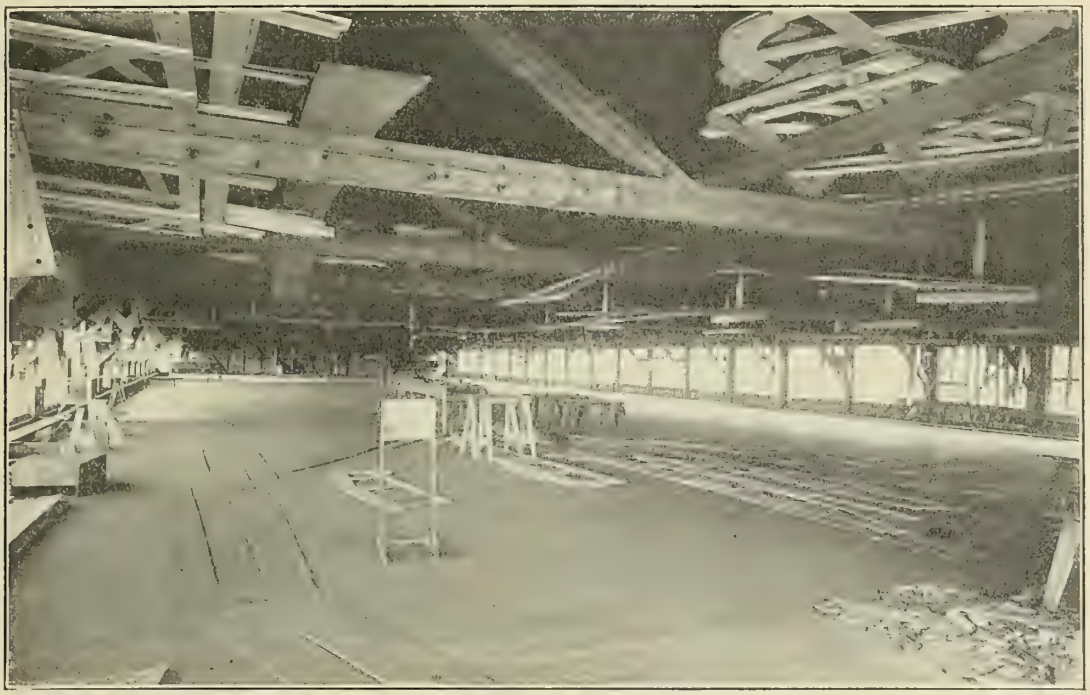


VIEW OF THE SHIPS, LOOKING UP THE YARD.

The blacksmith shop contains a large number of well arranged forges and two steam hammers. The air blast is supplied by a blower driven by a 35 horse power motor. The battery of four Erie fire-tube boilers furnishes steam at 125 pounds pressure, and is of 1,000 horse power capacity. Coal is conveyed from a large bin on the water front to the boilers by an overhead trolley. A coal wharf with run and derricks leads direct from deep water river frontage to the coal bin.

A large Worthington underwriters fire pump is used for fire protection, and maintains a pressure of 60 pounds in the mains which lead to several hydrants efficiently located in the yard.

Plates which are ready for the ship are carried from



MOLD LOFT.

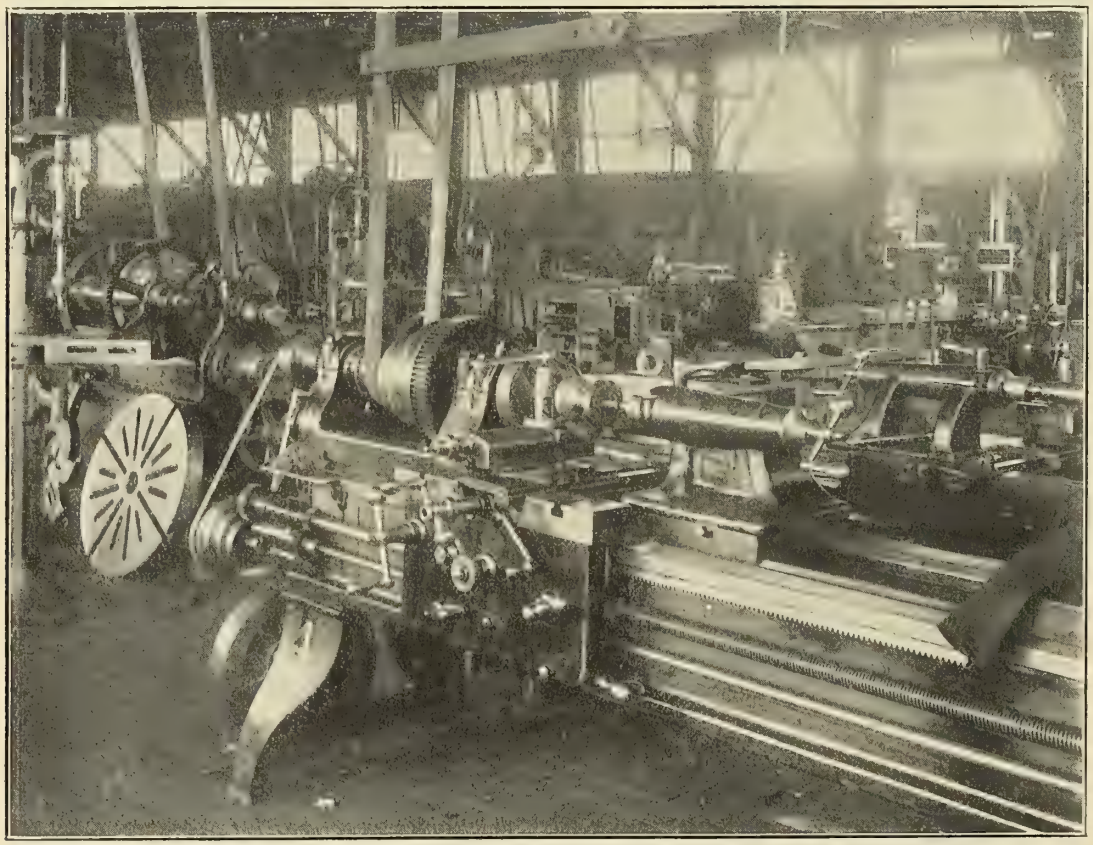
PIPE AND SHEET METAL SHOPS.

the plate shop on a double overhead conveyor, shown in the engraving on page 101, to the building ways, where they are picked up by the novel overhead wire rope trolley system and delivered in place on the ships.

Retracing our steps, however, across the central open space of the yard we will visit the remaining buildings to the east of the railroad tracks. The pipe and sheet iron shop, machine shop, mold loft and joiner shops are built at the east side of the railroad track. The nearest of these, the pipe shop, contains the usual pipe, sheet iron, lead, brass and copper tools. At present the only work for the machine shop is in finishing up the ship fittings and making the necessary repairs and improvements about the plant. A 350-horse power Erie engine drives the machinery for these shops, as well as the joiner shop, and also runs the dynamo used for electric power This latter is of 150 kilowatt capacity, and supplies the current at 250 volts. The machinery equipment was furnished by Hill, Clark and Company, Niles Tool Works, Jones and Lamson Machinery Company, Hilles and Jones, Manning, Maxwell and Moore and other makers and comprises several types and sizes of lathes, planers, drills, shears, grinders, milling machines, etc.

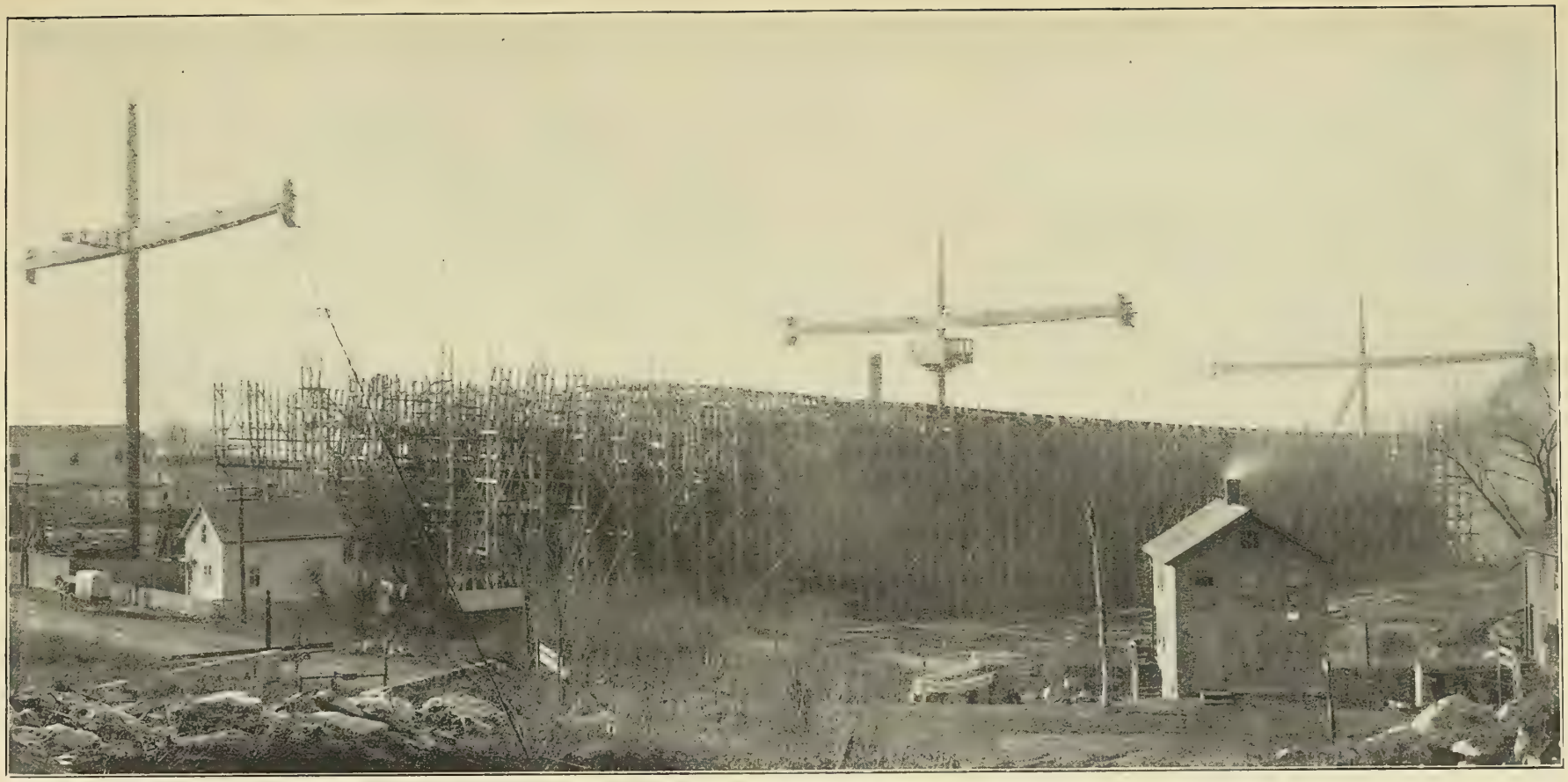
South of this shop are the temporary offices, 30 by 70 feet. On the main floor are the general offices, and above are the drafting rooms, divided into the hull, engine and scientific departments. All plans for the construction of the ships were gotten out here. Extending to the south are the joiner and machine shops and mold loft above mentioned. The former is located on the first floor and well equipped with first-class woodworking machinery. Most of the joiner work for the two ships has already been turned out. The mold loft floor above is built very substantially, and is laid on heavy timbers in two strakes of selected dried white pine. The floor is 250 by 70 feet, and here the full size body plan and lines were laid down. As these ships are of such great length, the midship section could be carried for a distance of over 150 feet and still leave sufficient length for a fine entrance and run.

In carrying out the details of construction templates were made for each frame, and longitudinal, and wherever possible the universal system was used for laying out the plating. By this system most of the deck and bulkhead plating is made of a standard size, with standard rivet spacing, such that a plate can be placed in almost any location on the deck or bulkhead. This system, which is extensively used on the Great Lakes, reduces greatly the time occupied in construction, and results in rapid and better as well as cheaper work.



MACHINE SHOP.

Returning to the shipbuilding berths where the ships have now assumed definite shape, we note an important feature in the equipment of this plant, which is the trolley system for conveying the material over the shipbuilding slips. Economy in large ship construction nowadays depends largely upon the shipyard facilities for handling material, and the essential points in such



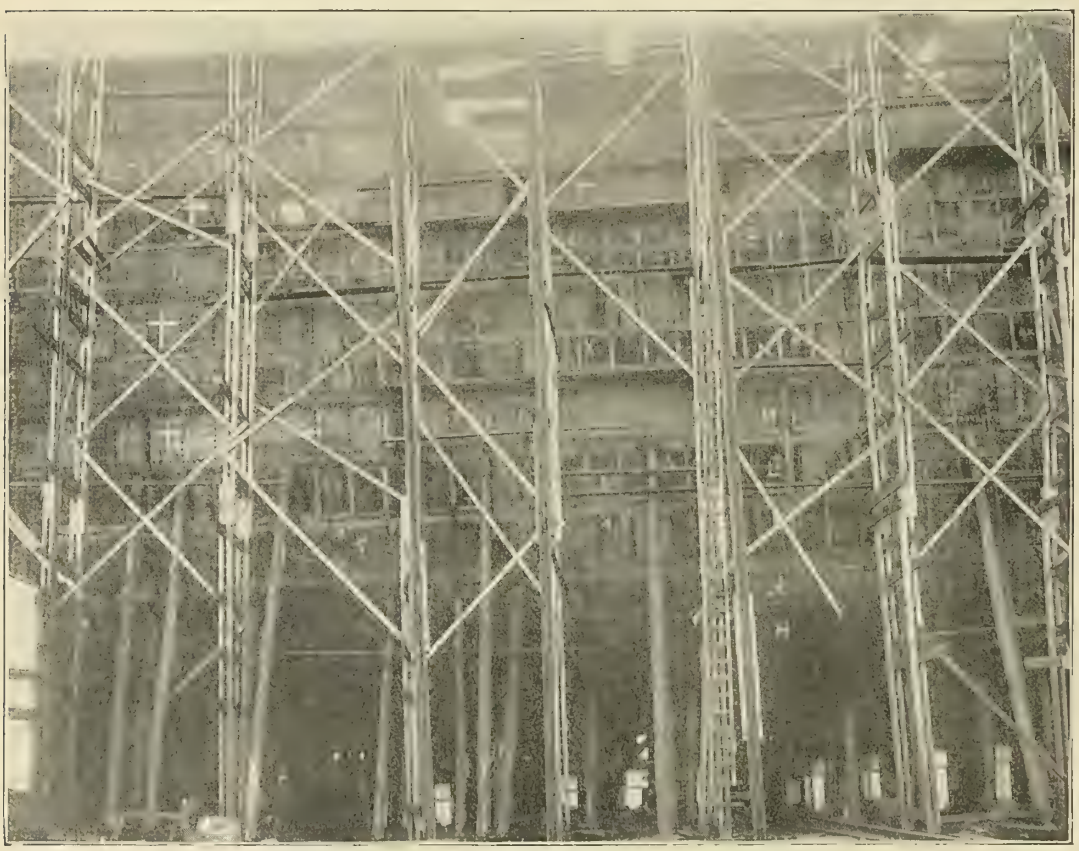
VIEW OF THE SHIPS AND THE OVERHEAD TROLLEY SYSTEM AT THE WORKS OF THE EASTERN SHIPBUILDING COMPANY.

a system must be, complete immunity from accidents, and a simple and rapid arrangement for hoisting and distributing where desired to any part of the vessel any plate or member entering into the construction of such a vessel. Speed of operating is of course an essential feature.

The trolley system installed at this yard was designed by President Hanscom, and is an enlargement of simpler methods installed by him in establishments with which he has formerly been connected. This system, which is shown in the engraving above, consists of three vertical masts erected between the ships, one at the bow, one at the stern and the third or central midway between the other two. These masts are about 140 feet high from foot to cap, and rest upon immense foundations. To each mast is fixed a large horizontal yard 170 feet long, built of rectangular section as light as consistent with the required strength. These yards are elevated 90 feet from the ground and at sufficient height to allow the plates and beams to clear the hulls now building and to be carried readily to the desired place.

The masts are securely stayed in the fore and aft directions by strong steel wire stays and guys securely anchored in rock. In addition to the water-end stay the after mast is held in position by a steel strut or compression strong back. Steadiness in an athwart-

JOINER SHOP.



VIEW OF THE SIDE OF A SHIP.

ship direction is obtained by steel guys similar to those forward and aft, running from the ends of the yards, and these are also securely anchored in rock. A strong fore and aft steel wire stay connects the end and middle of each yard, and diagonal wire rope guys run from the ends of each yard to each mast. The yards are supported from the masthead by large steel wire guys or lifts, and the two end yards are well braced and trussed with heavy wire rope tension guys. The working field of the trolleys is a large rectangle, 600 by 175 feet, supported over the vessels and securely held in position by masts and guys.

Material can be carried to any position in the rectangular field by means of fore and aft traveling carriages on thwartship moving cables suspended between cars running on tracks on top of the yards. The motion to the cars and carriages is obtained from electrically operated machinery, which was also built and designed by the Eastern Shipbuilding Company.

One of the strong points of this system is the speed at which the trolleys are operated. A load can be hoisted in ten seconds, the carriages in the tracks on the yard-arms move the cableway the complete length of the yard in thirty seconds, and the trolley carriage travels the length of the cableway in twenty-five seconds, all with full designed working load. The two trolleys have hoisted and put in position over 100 tons in a working day of ten hours.

This system possesses many advantages, the principal one of which is the very large number of usages to which the framework and guys of the structure can be placed. Such a system could be designed to take any number of traveling trolleys, each one having transverse and longitudinal motion, whereas other systems confine the number of hoists made at the same time to one or two.

The equipment is at present in successful operation at New London, and is fitted with ten traveling trolleys capable of working simultaneously.

When Professor Von Halle, of Germany, recently visited the New London yard he remarked that, "The overhead trolley system of handling material at the works of the Eastern Shipbuilding Company is the greatest feature of the most remarkable shipyard in the world."

Fast Motor Launch.—A French built boat, *Rollo V*, according to *La Locomotion Automobile*, has made extraordinary speed on many occasions. The boat has a 24 horse power gasolene engine, built by Panchard and Levessor, Paris. The hull is 39 feet 3 inches long and 4 feet 3 inches in beam. She is built of light and rigid construction and planked with three sheetings of cedar. This little boat has been increasing her speed since April 21st, when 14.9 miles were made at a speed of 11.5 miles per hour, to a speed over the same course in June last of 15.7 miles per hour.

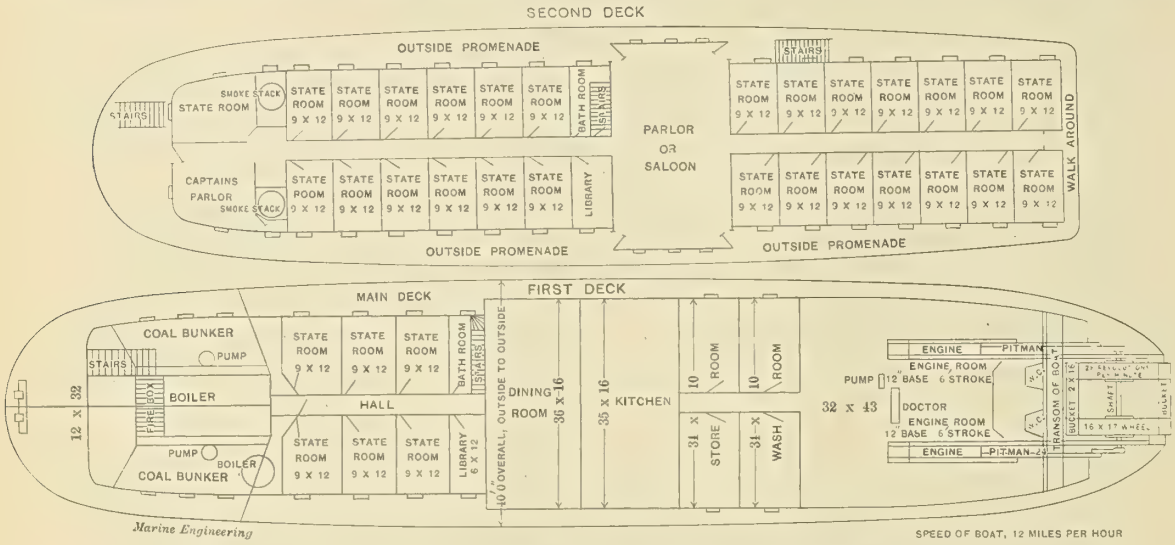
MISSISSIPPI RIVER MISSION BOAT MEGIDDO.

Mission Boat on the Mississippi.

A boat to fill a peculiar trade has recently been completed by M. J. Godfrey, of Lyons, Ia. The vessel which, is called the *Megiddo*, which interpreted means, "The Lord is in His place with an army," is to be used by the Association of Christian Brethren for mission work along the Mississippi. The *Megiddo* is of the usual style of western river boat with a large stern wheel, and has accommodations on board for taking care of 100 people. The accompanying deck plans show an admirable arrangement for this speciai service.

The hull is 175 feet long by 32 1-2 feet broad on the bottom, 36 feet on the deck and 40 feet over the guards, and is built from the best selected white oak posts from Virginia and Missouri. The fir used in the construction is from Washington, the pine from Maine, the hard pine from Georgia and the other hard wood from Wisconsin. On the main deck, aft of the forecastle, are the boiler-room, with coal bunkers, six staterooms, bathrooms, then a dining-room, kitchen, pantry, two storerooms and large engine-room. On the second deck are stairs and companion way, a large

captain's parlor and bedroom, and twelve staterooms and a ladies' parlor. Aft of this are fourteen staterooms. Above is the Texas with four staterooms, and on top of all is the square pilot house. The forecastle is screened off with shutters in bad weather. The engines and boilers are built by the Star Boiler Works, of Clinton, Iowa. The boiler is of the locomotive type, with shell 52 inches in diameter, 20 feet long over all, and with sixty-eight 3-inch tubes. There is also a 12-horse power donkey boiler for supplying steam heat. There are two high pressure engines, one mounted on either side of the vessel and driving the stern wheel, which is 17 feet in diameter with sixteen buckets 24 inches by 16 feet long. Each cylinder is 12 inches diameter by 6 feet stroke, and is fitted with California cut-off and balance valves. The usual "Doctor" is used for boiler supply and bilge pump, and there is one Gardner duplex pump and two deck pumps. The vessel is heated throughout with steam, and is lighted by acetylene gas.



DECK PLANS OF MISSISSIPPI RIVER STEAMBOAT MEGIDDO.

Trial of the Japanese Destroyer Kasumi.

The Japanese torpedo-boat destroyer *Kasumi*, built by Yarrow and Company, Ltd., Poplar, England, recently completed her official trial and attained the average speed of more than 31 knots over the measured mile. The vessel was launched on January 23, 1902, was taken on preliminary trial January 24th, and successfully completed the official trial on January 29th. This record of completing the trials within a week of the launching of the vessel speaks of the high class of work of this firm, and their extensive experience in this special line.

The official trial consisted of three hours continuous run, with a load of 40 tons on board, the speed being ascertained by six runs over the measured mile. The following is the record of these six runs.

Run.	Hour.	Air pressure in Stokehold.	Revolutions per minute.	Time.	Speed.	First Mean.	Second Mean.	Admiralty Mean.
	A. M.	IN.		M. S.				
1	11 13	.6	395.8	2 40	29.032	30.969		
2	11 24	.93	392.1	1 49.4	32.906	30.795	30.882	
3	11 33	.9	390.3	2 5.5	28.685	31.087	30.941	31.075 Knots on Measured Mile.
4	11 43	1.1	396.8	1 47.5	33.488	31.236	31.161	
5	11 54	1.1	398.1	2 4.2	28.985	31.394	31.315	
6	12 3	1.2	401.7	1 46.5	33.802			

After the six runs were made, to ascertain the advance per revolution of the screw, a three hours' trial was proceeded with, with the result that a mean speed during the three hours of 31.245 knots was obtained.

The American Shipbuilder has come out with a new dress of type improving quite materially the appearance of this well-known weekly.

Yarrow Water Tube Boilers.—The Austrian naval authorities have decided to adopt Yarrow Water Tube Boilers in the three battleships about to be laid down.

THE THEORETICAL AND PRACTICAL METHODS OF BALANCING MARINE ENGINES, II.*

BY NAVAL CONSTRUCTOR D. W. TAYLOR, U. S. N.

A Comprehensive Abstract of the Prize Paper Presented Before the Society of Naval Architects and Marine Engineers, November, 1901.

27. In this paragraph the author discusses the possibilities of balance with four cranks. The mathematical analysis is given in appendix C. The results of the investigation applied to 256 cases, spread over the ordinary range of proportions, are shown graphically in a large diagram not here reproduced. In this investigation the four cylinders are denoted by the numbers 1, 2, 3, 4, No. 1 being aft. The reciprocating weights are similarly denoted by w_1, w_2, w_3, w_4, the latter being considered as constant and equal to unity. The spacings of the cylinders from No. 1 are expressed in terms of the length of the engine taken as unity.

The chief features of importance in this diagram are summarized by the author as follows:—

From a study of this diagram, which covers the whole field of four-crank balance, we can readily determine that portion of the field worthy of final detailed investigation.

It will be observed in the first place, that where the crank angles are such as to give an evidently inferior turning moment, the resultant secondary force is usually large, and the relative reciprocating weights such as would be very difficult to obtain in practice.

In the second place, for arrangements where w_2 and w_3 range from 1 to 1.5, the secondary forces are not large, the crank angles approach reasonably close to those which we have seen give the most uniform turning moment, and w_1 does not differ greatly from w_4, which is assumed always as constant and equal to unity.

In the third place, the secondary force varies greatly, both in direction and magnitude, while the secondary moment varies comparatively little, indicating that while we may expect, by further manipulation of weights and angles, to eliminate secondary force, it will not be possible in practice to eliminate thus the secondary moment.

The obvious inference from the results shown in this diagram is that we need examine in detail only arrangements where cylinder No. 4, having unit reciprocating weight and zero crank angle:—

Cylinder No. 3 has reciprocating weight somewhere in the neighborhood of 1.5, and its crank angle in the second quadrant, ranging approximately from 135 to 160 degrees.

Cylinder No. 2 has reciprocating weight somewhere between 1 and 2, and its crank angle in the third quadrant and somewhat less than 270 degrees.

Cylinder No. 1 has reciprocating weight somewhere in the neighborhood of 1, and crank angle in the first quadrant, ranging, approximately, from 45 to 60 degrees.

MOST COMPLETE BALANCE ATTAINABLE WITH FOUR CRANKS.

28. As it is not to be expected that we shall be able to get rid of both secondary force and secondary moment by futher manipulation of weights and crank angles for four cranks, the next step in my investigation will be directed toward the determining of combinations where secondary forces, as well as primary forces and moments, are extinguished, and the resulting unbalanced secondary moment known.

In Appendix C will be found detailed the graphic methods followed, and their results are shown in diagrams A to G, which enable us to determine absolutely the crank angles and relative reciprocating weights for a four-crank engine, with any practicable cylinder spacing, for which primary and secondary forces and primary moments are extinguished. Such engines are upon the Yarrow, Schlick, and Tweedy system, and have been much used abroad, it is claimed, with great success. It is seen that the cylinder axes once located, the crank angles and relative weights follow, and are readily determined by simple inspection from diagrams A to F. While theoretically any order for the cylinders may be chosen, in practice, owing to the fact that the lightest weights must be on the end cranks, and that uniform turning moments are desirable, it is advisable to adopt the general arrangements outlined below.

For four-cylinder triple expansion engines the two low pressure cylinders should be outside, and their moving part should be as light as possible. Each low pressure cylinder does only about half the work of the high pressure or medium pressure, and it is desirable to have the low pressure connecting rods, crank pins, etc., reduced in due proportion.

For four-cylinder quadruple expansion engines the high pressure and M^1P. cylinders should be outside and the M^2P. and low pressure inside. Care must be taken to design the low pressure piston as light as practicable, and it is advisable to have the air pump, if worked by a lever, driven from the low pressure crosshead, as thus the low pressure reciprocating parts are virtually lightened.

It is advisable to have the forward pair of cylinders as close together as practicable, and the after pair also as close together as practicable. This result is facilitated if the valves for the two outer cylinders high pressure and M^1P. are placed at the ends of the engine, and the valves for the two inner cylinders M^2P. and low pressure in the middle.

Balance can be had without the precautions noted above, but with much greater additions of weights than would otherwise be needed.

REVOLVING BALANCE FOR FOUR CRANKS.

29. With a four-crank engine, balanced as regards the reciprocating weights, there are so many ways of obtaining revolving balance that it becomes a question of selecting that one having most practical advantages as regards simplicity and cheapness. The ideal method as regards balance alone is to fit proper counter-balance weights opposite each crank. If, however, the revolving force and moment polygons are plotted, it will be found that equally complete balance can be secured with less total addition of weight. If moments are taken about the after crank as usual, a revolving weight at the forward crank at a suitable angle will close the revolving moment polygon. This will, of course, mean an additional side to the revolving force polygon, but the latter can now be closed

*Continued from February number, page 66.

by a suitable weight at the proper angle at the after crank. In practice it is not convenient, as a rule, to apply balance weights at the cranks, unless they are on or opposite to the crank. So the most feasible plan in practice is to fit two revolving counter-balance weights, one aft of the engine framing and the other forward. The turning wheel can usually be made use of for the attachment of one of these weights, and if the forward end of the shaft is extended two or three inches, a wheel or disk for a forward balance weight is readily attached. Once the correct force and moment polygons are plotted, the amounts and angles of these weights are readily determined.

Before finally balancing revolving weights it is well to take advantage of any obvious methods for reducing the unbalanced resultants. This may often be done, for instance, by drilling holes in one or more solid crank pins, or filling one or more, when they are hollow, with lead or similar devices. The force and moment polygons will always show what is wanted and indicate the direction along which to work.

ENGINES WITH FIVE CRANKS.

30. It is not necessary to enter into a detailed analysis of the case of five-crank engines. With them perfect balance can be secured in a very simple manner.

We have seen that with three-crank engines, with cranks equally weighted and spaced, both primary and secondary forces are balanced. The balance, as regards forces, is even more complete than this. I have, throughout, taken the acceleration of reciprocating parts as proportioned to

$$\cos\theta + \frac{\cos 2\theta}{n}.$$

MacAlpine has shown that an even closer approximation is given by taking the acceleration as proportional to

$$\cos\theta + \cos 2\theta\left\{\frac{1}{n} + \frac{1}{4}\cdot\frac{1}{n^3} + \frac{15}{128n^5} \div \dots\right\}$$

$$-\cos 4\theta\left\{\frac{1}{4n^3} + \frac{3}{16n^5} + \dots\right\} + \cos 6\theta\left\{\frac{9}{128n^5} + \dots\right\}.$$

Now, with a three-crank engine, with cranks equally weighted and spaced, the resultant force due to terms

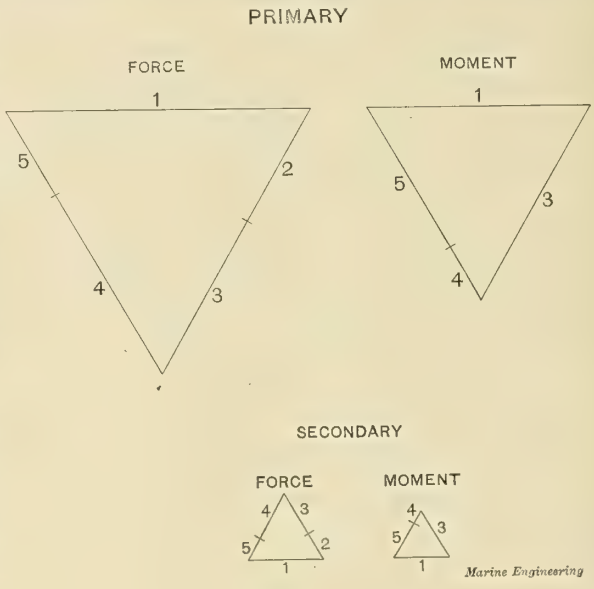


FIG. 13.

involving $\cos\theta$, $\cos 2\theta$, and $\cos 4\theta$, is zero, so that we may consider that primary, secondary, and tertiary forces all vanish.

Evidently, then, we should obtain almost an ideal balance with three-crank engines, as above, were it not for the fact that the cylinder axes, being not in the same line, moments are produced. Now, with a five-crank engine, we can make an arrangement virtually equivalent to a three-crank with cranks equally weighted and spaced, and the three cylinder axes coincident.

Two parallel cranks are equivalent to one crank with weight on it equal to the sum on the two, and located so that each of the two has the same moment about it.

To secure complete balance, then, with five cranks, it is necessary to arrange the heaviest weight in the middle, make the other cranks two and two parallel, one pair at 120 degrees with the middle crank, and the other pair at 240 degrees. Considering each pair, the moment of the weight on the forward crank about the middle one must be equal and opposite to the moment of the weight on the after parallel crank. Fig. 12 shows a diagrammatic arrangement with five cranks completely balanced, and Fig. 13 the corresponding primary and secondary force and moment polygons, which are seen to be equilateral triangles, one or more sides corresponding to two cylinders.

There has not been experience enough with the five-crank system to settle the best arrangements, but it is readily adapted to a quadruple engine with the first or second medium pressure divided into two. Fig. 12

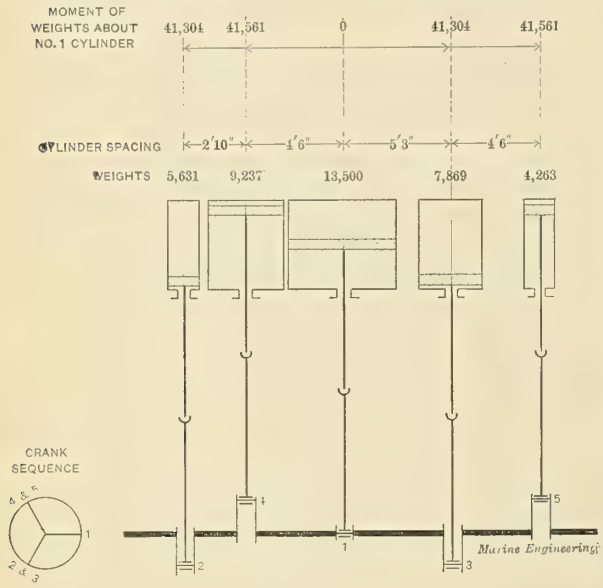


FIG. 12.

indicates the high pressure divided into two, but this appears undesirable for practical reasons. The two cranks corresponding to the divided cylinder should not be made parallel, but one should be parallel to the high pressure and one to the other medium pressure. This is for the purpose of gaining the most uniform turning moment possible. The five-crank completely balanced arrangement is practically as good as any arrangement as regards uniformity of turning moment.

REVOLVING BALANCE FOR FIVE CRANKS.

31. To secure complete revolving balance with the five-crank arrangement is not difficult. As a general thing the revolving weights would naturally be the same for each crank. If weight is added to the middle crank, and the revolving weights on each pair partially counter-balanced until for each pair the total virtual weight is equal to the virtual weight on the middle crank, and each one of the pair has the same moment about the middle crank, perfect revolving balance is secured. It is simpler and cheaper, however, to use two revolving balance weights, spaced as far apart as possible, as in the case of four-crank engines.

BALANCE INCLUDING VALVE GEAR AND OTHER SECONDARY WEIGHTS.

32. An engine might be completely balanced as regards the main moving parts and yet develop very serious unbalanced forces due to its other moving weights, such as valve gears, air pumps, etc.

It is impossible to discuss in detail the possible cases which may arise in connection with these. In Appendix B I have shown how to determine the effects of any type of weight likely to be met with in practice. In balancing, skill and experience in applying the methods I have described are essential, but the modifications necessary to handle valve gears and other secondary weights are very simple in principle. Take an eccentric valve gear, for instance. The eccentrics driving it will be set at certain angles ahead or behind the crank of the cylinder; and the position of the crank once determined, the effect of the valve gear weights can be obtained. So when balancing a four-crank engine, for instance, first neglect the valve gears, and determine crank angles and main weights. This can be done at once from my diagrams A to F when the spacing of cylinders has been fixed. Then using these crank angles, determine the resultant unbalanced forces due to the valve gears. Next make a second approximation to the main gear weights and angles, so determining them that they are not in perfect balance with each other but balance the valve gears. In rare cases it may be necessary to repeat this process, but as a rule the second approximation to the main crank angles and weights is practically exact. The above is peculiarly applicable to the four-crank engine, where crank angles are varied in balancing. Engines with three or fewer cranks cannot be balanced anyhow. For five-crank engines with cranks 120 degrees apart, the valve gears must be balanced independently like the main gears. This is very simple, if the valves all supply steam on the outside or all on the inside. Then the eccentrics all have practically the same angular advance, and balancing is a question of weighting, which is easily arranged for.

TABLE IV.

DATA GIVEN FOR ONE ENGINE IN EACH CASE.

	NAME OF VESSEL.														
	Charleston		Yorktown.			Vesuvius.				Cushing.					
No. of cylinders	2		3			4				5					
Length of stroke—feet	3.0		2.50			1.6667				1.25					
Length of crank arm—feet	1.5		1.25			0.8333				0.625					
Length of conn. rod—feet	6		5.333			3.75				3.125					
Value of N	4		4.267			4.5				5.0					
Max. I. H. P.	3333		1696			1897				860					
Max. revs. per minute	115		160			280				370					
Value of .000341 R^2	6.765		10.912			22.278				29.177					
Cylinder No.	1	2	1	2	3	1	2	3	4	1	2	3	4	5	
Aft or forward	Aft.	Ford.	Aft.		Ford.	Aft.			Ford.	Aft.				Ford.	
Leverage about aft crank—feet	0	6.75	0	5.65	925	0	3.5	7.5	11.0	0	3.50	9.00	132.5	17.25	
Crank ahead forward crank—degrees	270	0	120	240	0	90	270	180	0	216	72	288	144	0	
Actual recip. wt.—lbs	10000	6800	3000	2200	1800	1080	1080	1010	860	210	210	210	210	210	
Moment for primary polygon	0	45900	0	12430	16650	0	3780	7575	9460	0	735	1890	2782.5	3622.5	
Angle for secondary polygon	540	0	240	480	0	180	540	360	0	432	144	576	288	0	
Wt. for secondary polygon	2500	1700	703	516	422	240	240	224	191	42	42	42	42	42	
Moment for secondary polygon	0	11475	0	2913	3902	0	840	1683	2102	0	147	378	556.5	724.5	

Revolving secondary weights are easily combined with the main revolving weights, and if two revolving balance weights, spaced as far apart as possible, are used, they can readily be arranged to balance all revolving weights, main and secondary. One great advantage of this method of securing revolving balance is, that with provision made for the two balance weights, their exact amounts and angles need not be settled until the engine is practically completed and the exact revolving weights to be balanced known.

IMPORTANCE OF DRAWING FORCE AND MOMENT POLYGONS

33. In conclusion, I would recommend in the strongest manner that when designing an engine, whether for balance or not, complete force and moment polygons be always drawn, representing the effects of *every moving weight*, the weights being estimated. For completed engines, *actual weights* should be obtained and used for the polygons.

If complete or partial balance is aimed at, these polygons, correctly drawn, enable us to determine at a glance how closely the desired results have been obtained. As illustrating this, reference may be made to Fig. 6, showing the polygons for the five-crank engines of the *Cushing*. The force polygons are closed and the moment polygons have material resultants. It is evident that if the angles of the first and third cranks were interchanged the force polygons would still be closed, while the unbalanced moment resultants, both primary and secondary, would be but fractions of what they are in Fig. 6.

APPENDIX B.
Discussion of Various Appendages.

GENERAL PRINCIPLES.

1. In addition to the piston, piston rod, crosshead, connecting rod, crank pin, and crank arms, usually called the main gear, there are many moving parts, as a rule smaller and subsidiary, connected with every engine, such as valve gear, direct driven air pumps, etc.

The work of determining the effect of such weights as regards unbalanced forces and moments is, as a rule, more complicated than that of handling the main gear. The principles involved, however, are comparatively simple, and, with a systematic and orderly arrangement of the calculations, there is no difficulty in reaching correct results.

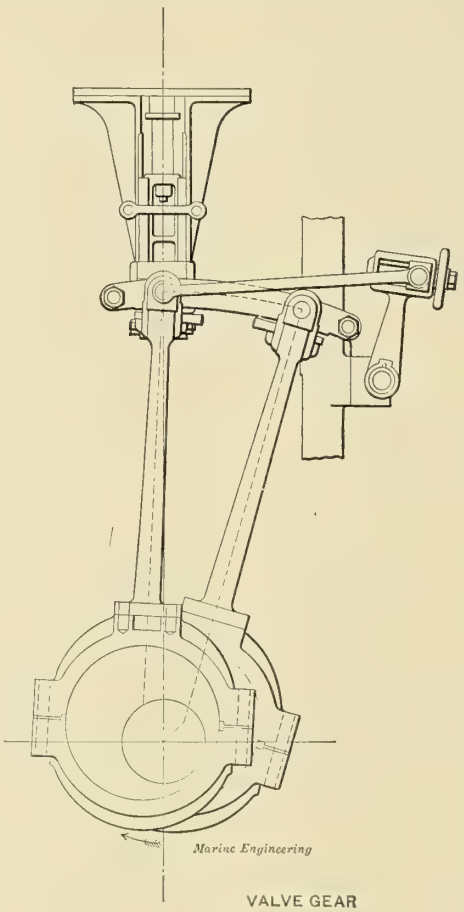
In handling such weights it is advisable always to reduce them as soon as possible to virtual weights, having the travel of the piston for reciprocating weights and revolving with the crank radius for revolving weights. The advantage of this is that one scale can be used for polygons of the secondary weights and main weights, and, in fact, one polygon can be drawn for both main and secondary weights.

In reducing the secondary weights to virtual weights having the same motion as the main weights, there is one point requiring especial care. As a rule, secondary reciprocating weights have not only a different stroke, but a different connecting-rod ratio from the main weights. For such a weight the virtual weight for primary diagrams is obtained very simply by multiplying it by the ratio (in all practical cases a fraction) between the travel of the secondary weight and the stroke of the engine. For the secondary diagrams, however, it is necessary to multiply this equivalent primary weight again, not by the connecting-rod ratio of the main weights, but by the connecting-rod ratio of the secondary weight.

The methods to be followed in dealing with the secondary weights can be best made clear from examples. I shall take three examples which will cover the ground as regards any case likely to occur in practice. They are:—

1. The ordinary double eccentric sliding link valve gear.

2. An air pump, lever driven from a crosshead.



VALVE GEAR

FIG. 14.

3. A bilge pump, eccentric driven from the main shaft.

VALVE GEAR.

2. The sketch, Fig. 14, which is not drawn to scale, shows an ordinary double eccentric valve gear in the go-ahead position, the data for it being as follows:—

DIMENSIONS.

Stroke of engine	42 inches.
Connecting-rod ratio for engine	4
Travel of valve	6 "
Eccentric rod length from center of sheave to center of top pin	84 "
Steam admitted on outside of valve	
Angular advance of eccentrics	135 degrees.

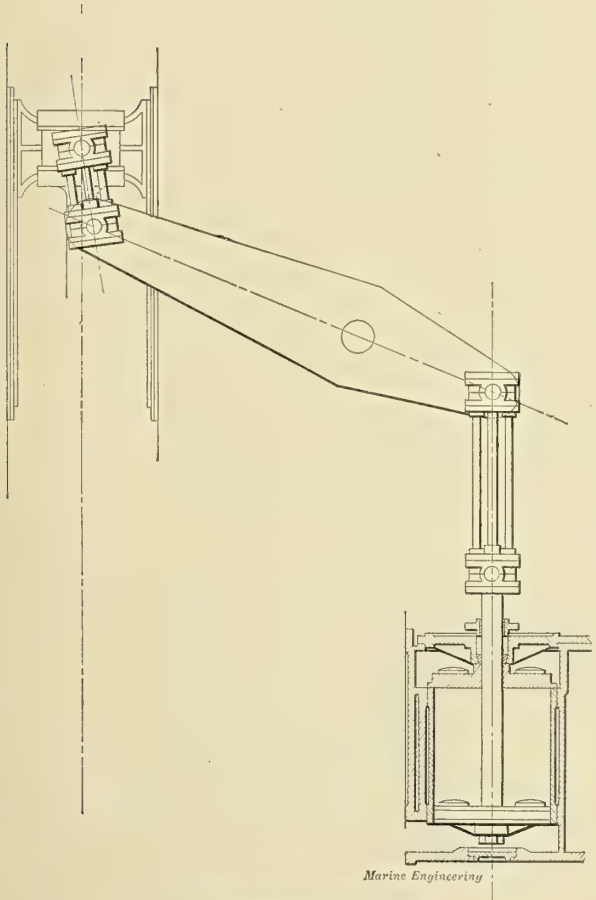
WEIGHTS.

Weight of valve, balance piston, valve stem and radius link block	1,446 lbs.
Weight of radius links	160 "
Weight of drag links or reversing links	92 "
Total weight of each eccentric rod and strap.	480 "
Weight of top half of eccentric rod	125 "
Weight of each eccentric sheave	275 "

It is necessary to separate the ahead gear from the astern gear and the revolving from the reciprocating weights.

The angular advance being 135 degrees, the ahead gear is driven by a crank 135 degrees ahead of the main crank of the cylinder to which the valve belongs, the astern gear by a crank 135 degrees behind, or preferably $360 - 135 = 225°$ ahead of the main crank.

	Ahead Gear.			Astern Gear.	
	Total. Weight.	Regarded as Reciprocating.	Regarded as Revolving.	Regarded as Reciprocating.	Regarded as Revolving.
Valve and rigid attachment	1446	1446	—	—	—
Radius links	160	80	—	80	—
Drag links	92	46	—	—	—
Eccentric rod and strap	480	125	355	125	355
Eccentric sheave	275	—	275	—	275
Totals		1698	630	205	630
Virtual primary weights—Factor $\frac{1}{7}$	—	243	90	29	90
Virtual secondary weights—Factor $\frac{1}{196}$	—	9	—	1	—
Crank ahead of cylinder crank		135°		225°	



LEVER DRIVEN AIR PUMP

FIG. 15.

The connecting-rod ratio for the valve gear is $\frac{3}{84} = \frac{1}{28}$.

The travel of the valve being six inches and the engine stroke forty-two inches, the primary reduction factor for the primary polygon is $\frac{6}{42} = \frac{1}{7}$. Since the connecting-rod ratio for the valve gear is $\frac{3}{84} = \frac{1}{28}$, for the secondary polygons the reduction factor becomes $\frac{6}{42} \times \frac{1}{28} = \frac{1}{196}$.

Taking up now the weights, first separate the actual weights into ahead and astern, reciprocating and revolving.

The first item—valve and rigid attachments—is all reciprocating and all belongs to the ahead gear.

The second item is 160 pounds for radius links. The radius links are driven by both the ahead and astern gear. They reciprocate with motion not absolutely harmonic, but it is an ample approximation if we divide the weight equally between the ahead and astern gear, giving 80 pounds to each.

The drag links, or reversing links, weigh 92 pounds. One end is at rest while the other reciprocates with the valve stem, since, as shown in the figure, these links take hold on the go-ahead end of the radius links. So we add 46 pounds to the go-ahead reciprocating weights.

Next we have the eccentric rod and strap. There is one for the ahead gear and one for the astern gear. This weight is like that of a connecting rod (which it is in essence) partly reciprocating and partly revolving, being concentrated at the two ends in the inverse ratio of the distances of its center of gravity

from the ends. In practice a very close approximation is obtained by regarding the weight of the top half of the rod as concentrated at the eccentric center and revolving. So for both ahead and astern gears we have, from the eccentric rods, 125 pounds reciprocating and 355 revolving.

The eccentric sheaves are, of course, all revolving, adding 275 pounds to both ahead and astern revolving weights.

LEVER DRIVEN AIR PUMPS.

3. Fig. 15 shows a very common type of appendage, namely, an air pump lever driven from the crosshead. Fig. 16 shows diagrammatically the dimensions and weights.

The simplest method of procedure is to determine the combined center of gravity of the whole gear, which, being driven off the crosshead, shares in its motion. This is done in the table below:—

Wt.	Amount Lbs.	Leverage about Lever axis.	Moment about Lever axis.
Crosshead links	120	— 40″	— 4800
Levers	570	— 7″	— 3990
Pump links	195	20″	3900
Reciprocating pump gear	1260	20″	25200
Sums	2145	9.47	20310

It is necessary now to collect the actual weights and apply the factors of reduction, by which we get the corresponding virtual weights reduced to engine strokes, etc.

The work is conveniently done in tabular form as indicated on page 113:—

The above gives us all the information to enable us to add to the main gear polygons lines covering the valve gear.

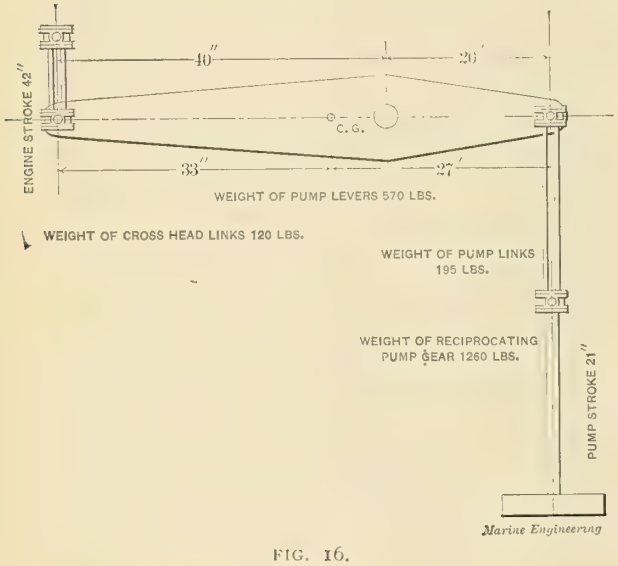


FIG. 16.

Now 2,145 pounds with a moment of 20,310 inch-pounds would be completely balanced by a weight at the crosshead end of the levers of 507.75 pounds. The effect of the air pumps as above, then, is to virtually reduce the reciprocating weight of the cylinder to which it is attached by 507.75 pounds. It will be

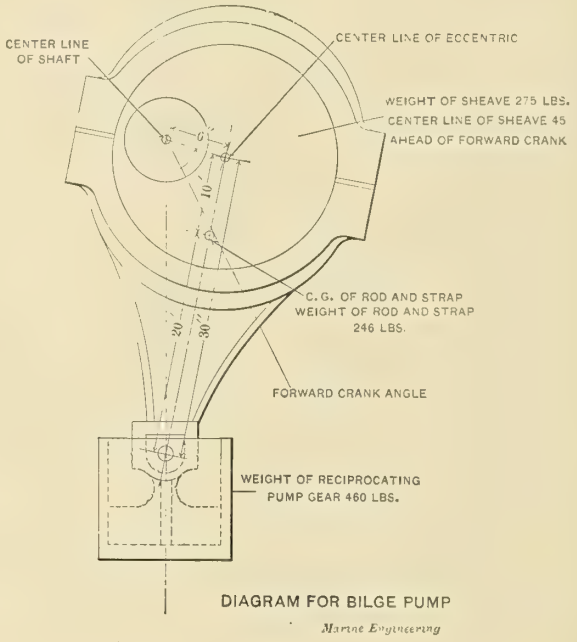

CENTER LINE OF SHAFT
CENTER LINE OF ECCENTRIC
WEIGHT OF SHEAVE 275 LBS.
CENTER LINE OF SHEAVE 45 AHEAD OF FORWARD CRANK
10
C. G. OF ROD AND STRAP
WEIGHT OF ROD AND STRAP 246 LBS.
20
30
FORWARD CRANK ANGLE
WEIGHT OF RECIPROCATING PUMP GEAR 460 LBS.
DIAGRAM FOR BILGE PUMP
Marine Engineering

FIG. 17.

If, as I consider desirable in practice, the secondary polygons are drawn with the same length of side as the primary, and the reduction factor or connecting rod ratio applied only to the resultants, the virtual secondary weights to be used in such case would be, for the engine in question (connecting-rod ratio = 4), four times as great as given above, the factor used being $1/196 \times 4 = 1/49$.

The moments follow directly from the weights, given the leverage of the valve center about the after crank.

observed that I neglected the obliquity of the links at the lever ends. This is because the effect of this obliquity upon the motion is infinitesimal.

BILGE PUMP ECCENTRIC DRIVEN.

4. The third and last type of auxiliary which I shall consider is that of a bilge pump eccentric driven.

Fig. 17 shows diagrammatically such an appendage.

Stroke of engine is taken as 84 inches, which is seven times the pump stroke. Connecting-rod ratio for engine is 4 and for the pump is 30/6=5. Center of

pump is 10 feet forward of after crank center. In the case of this appendage we have a slight complication, owing to the fact that the bilge pump is below the shaft instead of above, as the cylinders are. A little consideration will make it obvious that primary polygons are not affected, but for secondary polygons the sides must be measured in the opposite direction to the crank direction obtained by doubling the actual angle, a result which is most conveniently reached by regarding the sides of the secondary polygons representing this appendage as negative. The methods applicable to this case are obvious, and the table below shows their application.

Items.	Actual Weight.	Regarded as Reciprocating.	Regarded as Revolving.
Eccentric sheave	275	....	275
Eccentric rod and strap	246	82	164
Reciprocating pump gear	460	460	....
Totals	...	542	439
Virtual primary weights—factor $\frac{1}{7}$	....	77	63
Virtual secondary weights—factor $\frac{1}{7} \times \frac{6}{30}$	....	—15.5	....
Virtual primary moments—factor $\frac{10}{7}$	....	774	627
Virtual secondary moments—factor $\frac{10}{35}$	....	—155	....

If, as I recommend, it is intended to draw secondary polygons with sides the same length as primary polygons, applying the connecting-rod ratio of the main gear, afterwards the factor for virtual secondary weights becomes 4/35, and for virtual secondary moments 40/35.

These make the virtual secondary weight for the reciprocating secondary force polygon 61.9, and the virtual secondary moment 619.

APPENDIX C.

Analysis and Discussion of Four-Crank Balance.

PRELIMINARY DEFINITIONS AND CONSIDERATIONS.

1. In taking up the question of the balancing possibilities, so to speak, of the four-crank engine, it seems desirable at first to cover the whole practicable field by determining crank angles and weights for primary balance throughout the range of possible cylinder spacings liable to occur in practice. In doing this I designate the cylinders by the numbers 1, 2, 3, and 4; No. 1 being aft, and No. 4 forward; then the reciprocating weights for the respective cylinders are denoted by w_1, w_2, w_3, w_4. The crank angles are measured in the direction of rotation from the direction of the forward crank. This is simply a matter of convenience. Any direction fixed with relation to the crank shaft could be used, but just as it is convenient to take moments about the after center, so it is convenient to measure angles from the forward crank. Another point to be noted in this connection is, that as long as the angles are measured in the same direction, they may be laid off either forward or backward; that is to say, all in the direction of rotation, or all opposite to the direction of rotation. This is a matter which may be of some importance when considering turning moments. The crank angles, then, referred to the direction of the forward or No. 4 crank, are denoted by a_1, a_2, a_3, and a_4, the latter being always =0. As moments are taken about the after center, the distances or levers are measured from the after center. The distances, then, from the after center to the centers of the second, third, and fourth cylinder are denoted by l_2, l_3, and l_4. Since what we have to consider are ratios rather than absolute values, we may take any one reciprocating weight as always equal to unity and determine the ratios of the rest to it, and any one length as equal to unity and determine the ratios of the other lengths to it. It is evidently convenient to take the length of the engine from the after to the forward cylinder as unity—or l_4—equal to unity. It naturally follows, then, that we assume the forward reciprocating weight, or w_4, also equal to unity.

I invite attention now to Fig. 18, which shows the force and moment polygons both primary and secondary for a four-cylinder engine, as described above. It is seen that the primary moment and primary force polygons are both closed—that is to say, return to the origin, 0. The secondary force and moment polygons are open—that is, there is a resultant. For convenience, the sides of the secondary polygons are the same length as the corresponding sides of the primary polygons, but it should be understood that the actual corresponding forces are, for the secondary, only $\frac{1}{n}$ those of the primary polygons where n is the connecting-rod ratio. The angles in every case are measured counter-clockwise from the direction OA. In the secondary polygons this may, and usually does, result in some angles being greater than 360 degrees. Thus, in the primary polygons, a_2 is about 255 degrees, so that $2a_2$ is about 510 degrees, or 360 plus 150.

DEDUCTION OF FORMULÆ FOR ANGLES AND WEIGHTS NOT ASSUMED AS KNOWN AND FOR RESULTANTS.

2. It is necessary next to deduce expressions or formulæ connecting the lengths of the sides and angles of the primary polygons, which are closed, and then to determine the resultants in the case of the open secondary polygons.

Consider, first, the primary moment polygon: This involves only the second, third, and fourth cylinders, since moments are taken about the first cylinder, and hence its moment is always zero. We assume that we know w_2, w_3, w_4, l_2, l_3, and l_4, and hence w_2l_2, w_3l_3, and w_4l_4.

From well-known trigonometric formulæ, we have from the primary moment polygon.

$$\cos OAB = \frac{\overline{OA}^2 + \overline{AB}^2 - \overline{BO}^2}{2\,OA \times AB} = \frac{w_4 l_4 + w_3 l_3 - w_2 l_2}{2\,w_4 l_4 w_3 l_3}.$$

Whence, as w_4 and l_4 are each taken equal to unity,

$$\cos (180° - a_3) = \frac{1 + \overline{w_3 l_3}^2 - \overline{w_2 l_2}^2}{2\,w_3 l_3}.$$

Similarly

$$BOA = a_2 - 180°.$$

$$\cos BOA = \cos (a_2 - 180°) = \frac{1 - \overline{w_3 l_3}^2 + \overline{w_2 l_2}^2}{2\,w_2 l_2}.$$

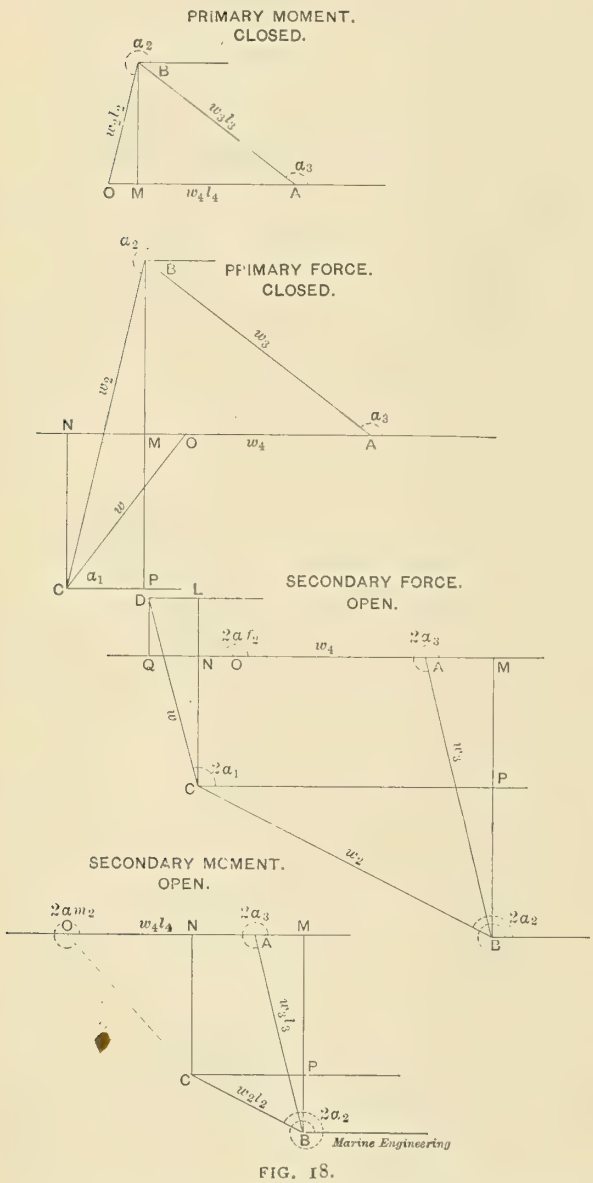


FIG. 18.

The above determine a_2 and a_3 the only unknown quantities in connection with the second and third cylinders.

It is next necessary to determine the weight and crank angle for the first cylinder. For this we use the primary force polygon. The formulæ are as follows:—

The polygon being closed, and each line being measured from the first extremity indicated to the second (*i. e.*, OA is a distance from O to A and AO is a distance from A to O), we have in the primary force polygon of Fig. 18.

$$OA + AM + MN + NO = 0,$$

or

$$1 + w_3 \cos a_3 + w_2 \cos a_2 + w_1 \cos a_1 = 0.$$

Also,

$MB + BP + CN = 0$, or $w_3 \sin a_3 + w_2 \sin a_2 + w_1 \sin a_1 = 0$.

Whence

$$\tan a_1 = \frac{w_3 \sin a_3 + w_2 \sin a_2}{1 + w_3 \cos a_3 + w_2 \cos a_2}$$

$$w_1 = \{(1 + w_3 \cos a_3 + w_2 \cos a_2)^2 + (w_3 \sin a_3 + w_2 \sin a_2)^2\}^{1/2}.$$

It is next necessary to determine the resultants in

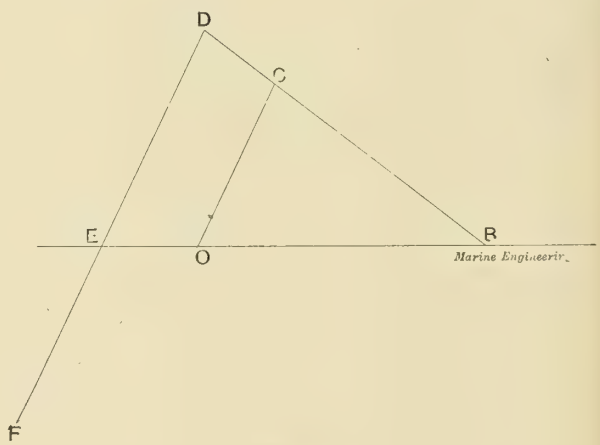


FIG. 19.

the secondary force and moment polygons. Referring to the open secondary force polygon, we have

$$OQ = OA + AM + PC + LD,$$
$$QD = MB + BP + CL.$$

The resultant OD is n times the unbalanced secondary force $= nf_2$ say. Denote the angle DOM by $2af_2$. Then

$$OQ = nf_2 \cos 2a_{f_2} = 1 + w_3 \cos 2a_3 + w_2 \cos 2a_2 + w_1 \cos 2a_1,$$
$$QD = nf_2 \sin 2a_{f_2} = w_3 \sin 2a_3 + w_2 \sin 2a_2 + w_1 \sin 2a_1.$$

Whence

$$\tan 2a_{f_2} = \frac{w_3 \sin 2a_3 + w_2 \sin 2a_2 + w_1 \sin 2a_1}{1 + w_3 \cos 2a_3 + w_2 \cos 2a_2 + w_1 \cos 2a_1},$$

$$nf_2 = \{(1 + w_3 \cos 2a_3 + w_2 \cos 2a_2 + w_1 \cos 2a_1)^2 + (w_3 \sin 2a_3 + w_2 \sin 2a_2 + w_1 \sin 2a_1)^2\}^{1/2}.$$

Finally, for the determination of the resultant secondary moment, referring to the open secondary moment polygon, we have, if nm_2 denote the secondary moment and $2am_2$ its angle

$$ON = OC \cos NOC = nm_2 \cos 2\,am_2$$
$$= OA + AM + PC = 1 + w_3 l_3 \cos 2a_3 + w_2 l_2 \cos 2a_2,$$
$$NC = OC \sin NOC = nm_2 \sin 2am_2$$
$$= MB + BP = w_3 l_3 \sin 2a_3 + w_2 l_2 \sin 2a_2.$$

Whence

$$\tan 2a_{m_2} = \frac{w_3 l_3 \sin 2a_3 + w_2 l_2 \sin 2a_2}{1 + w_3 l_3 \cos 2a_3 + w_2 l_2 \cos 2a_2},$$

$$nm_2 = \{(1 + w_3 l_3 \cos 2a_3 + w_2 l_2 \cos 2a_2)^2 + (w_3 l_3 \sin 2a_3 + w_2 l_2 \sin 2a_2)^2\}^{\frac{1}{2}}.$$

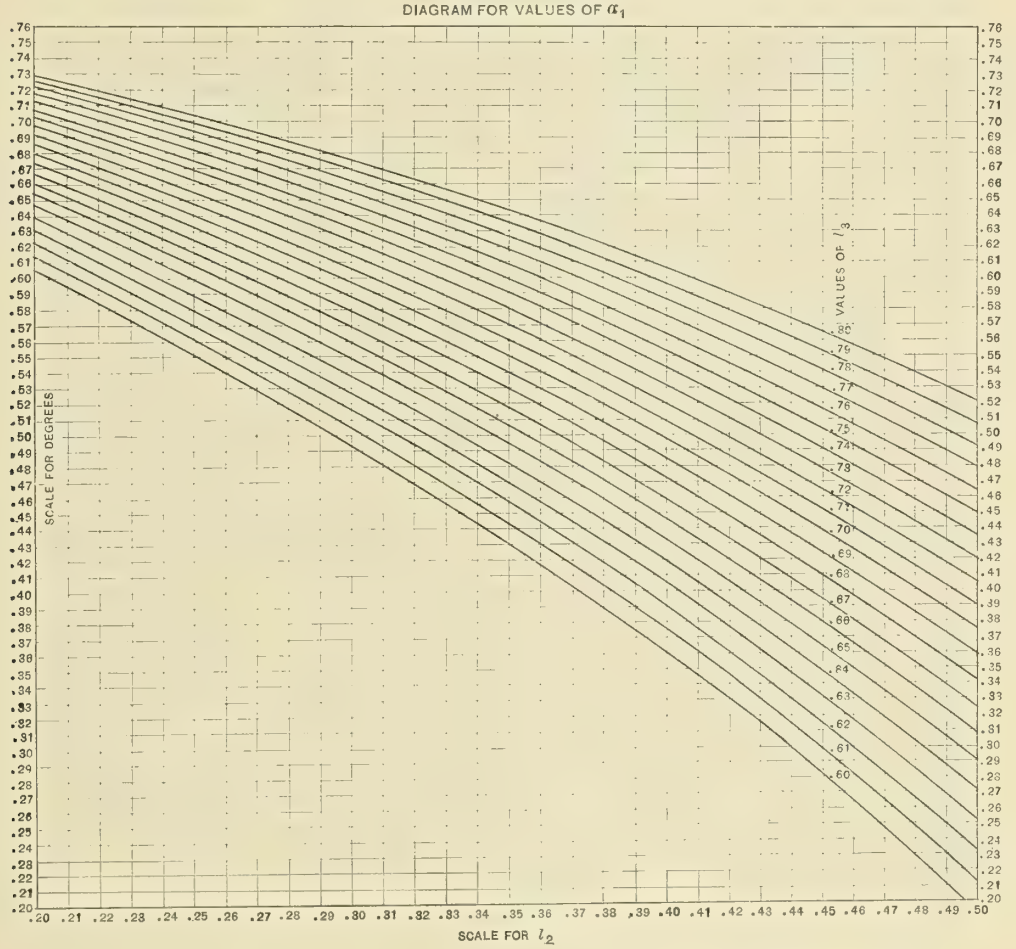
GRAPHIC REPRESENTATION OF RESULTS OF FORMULÆ AND CONCLUSIONS.

The author herein further discusses the diagram, reference to which has been made in section 27, closing with the following summary:—

A final fact, which is evident from the diagram, is that the best results as regards turning moment and residuary secondary force and moment appear to be developed when the second and third weights are both somewhere near 1.5. When this is the case, the first weight is generally not far from unity, or the value of the fourth weight, and in general the distribution of crank angles and weights is good. It is evident from this diagram that detailed investigation then may be restricted to combinations in which the angle of the first crank is from about 40 degrees to about 60 degrees; the angle of the second is something less than 270 degrees, and the angle of the third some 20 to 40 degrees less than 180 degrees. It is evident, moreover, from the diagram, that it will be practically impossible to eliminate altogether resultant secondary moments, while it appears probable that resultant secondary forces can be eliminated. The problem is then to determine the combinations where primary forces and moments are all eliminated, and then determine the corresponding resultant secondary moments. I have found that this can be done without a prohibitive amount of labor by a new graphic process.

DIAGRAM A.

DIAGRAM FOR VALUES OF a_1



DETERMINATION OF DIAGRAMS FOR FOUR-CRANK BALANCE, WHICH IS COMPLETE EXCEPT AS TO SECONDARY MOMENTS.

4. Referring to Fig. 19, suppose that *OBC* is a closed moment polygon, and *OBDF* the three corresponding sides of a primary force polygon, then we have

From the moment polygon:—	From the force polygon:—
$OB = w_4 l_4$	$OB = w_4$
$BC = w_3 l_3$	$BD = w_3$
$CO = w_2 l_2$	$DF = w_2$
$OB = BC \frac{w_4 l_4}{w_3 l_3}$.	$OB = BD \frac{w_4}{w_3}$

Whence

$$BD \frac{w_4}{w_3} = BC \frac{w_4 l_4}{w_3 l_3}$$

$$BD = BC \frac{l_4}{l_3}$$

DIAGRAM B.

DIAGRAM FOR RATIOS $W_1 \div W_4$

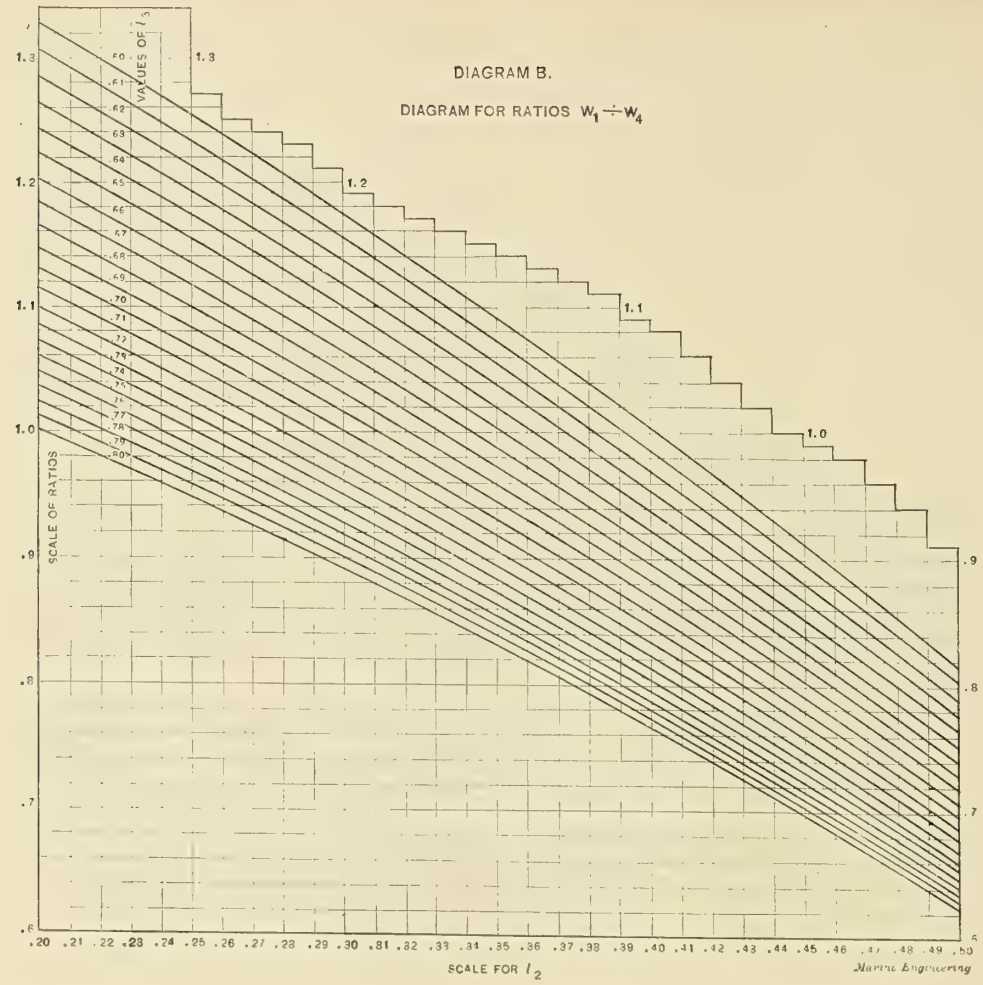


DIAGRAM C.

DIAGRAM FOR VALUES OF a_2

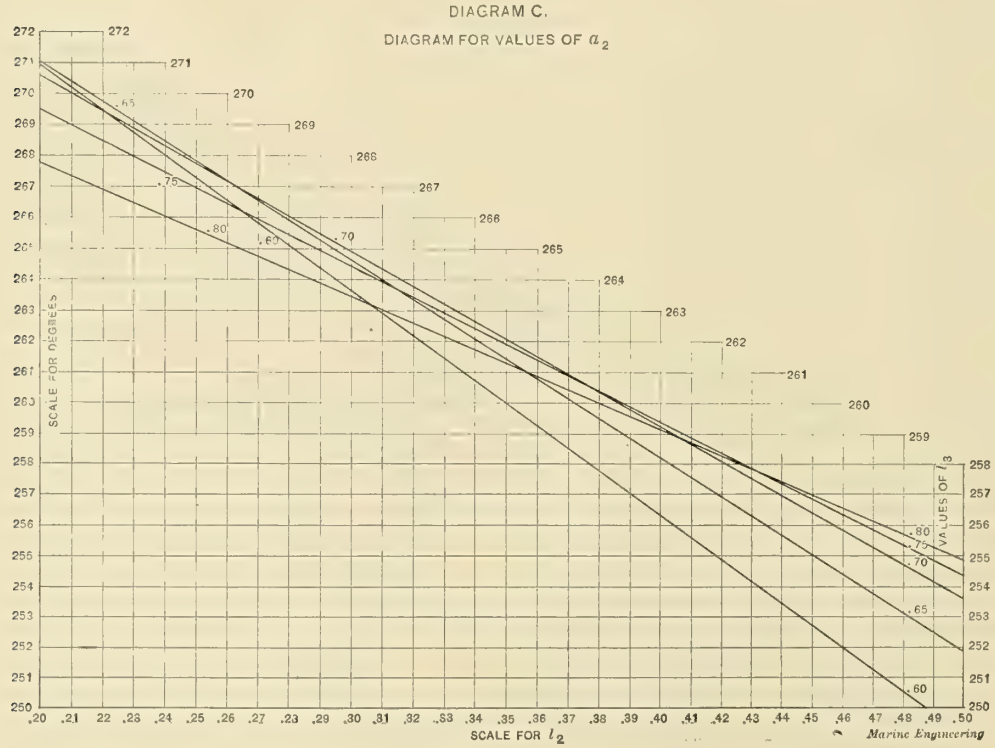


DIAGRAM D.

DIAGRAM FOR RATIOS $W_2 \div W_4$

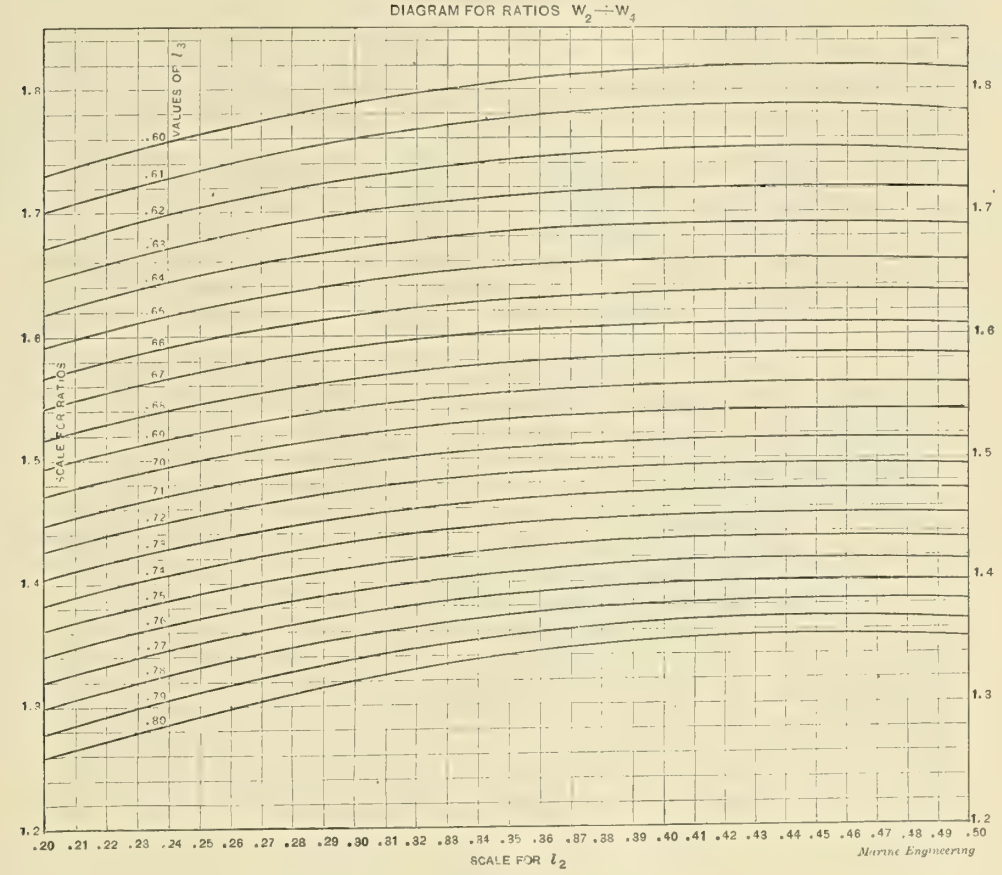
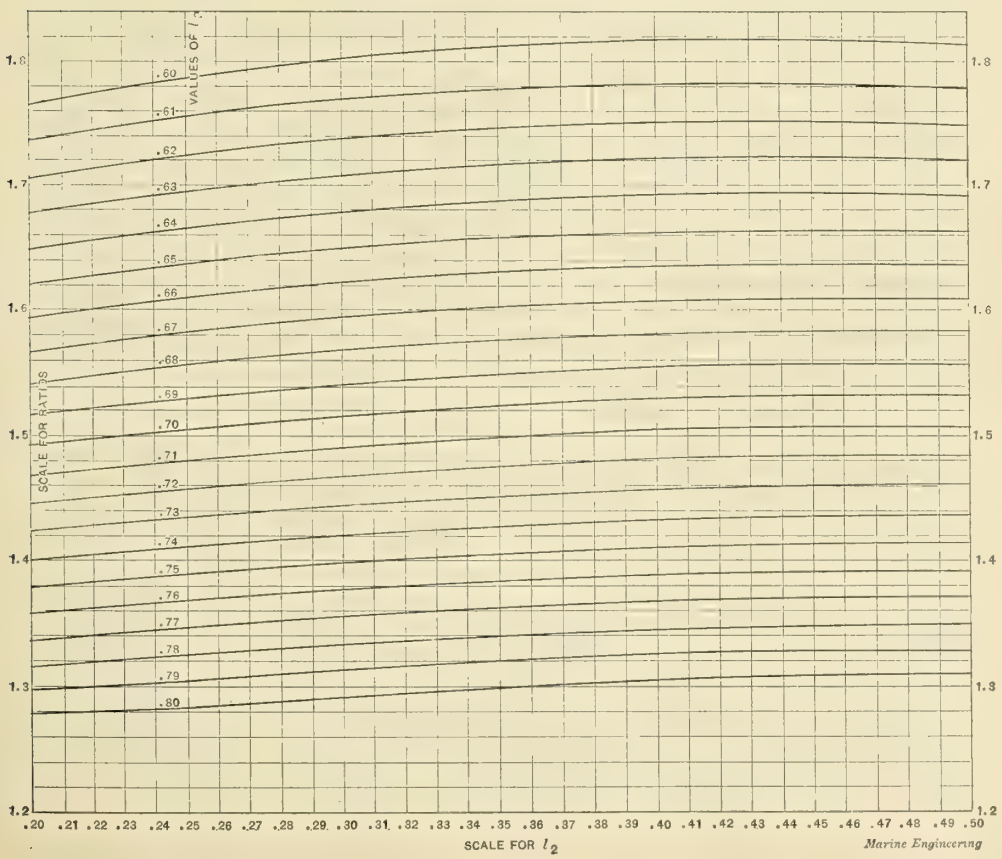


DIAGRAM F.

DIAGRAM FOR RATIOS $W_3 \div W_4$



$$CD = BD - BC = BC\frac{l_4 - l_3}{l_3}$$

Now by similar triangles

$$\frac{OE}{OB} = \frac{CD}{CB} = \frac{l_4 - l_3}{l_3}$$

Whence for given relative values of l_4 and l_3 and a constant value of BO or w_4, the line DF of the force polygon representing w_2 passes always through a fixed point E on BO extended. Furthermore, DF is divided at the point E in a ratio depending on l_2 and l_3.

For

$$DF = OC\frac{l_4}{l_2}. \quad DE = OC\frac{l_4}{l_3}.$$

Whence, finally,

$$\frac{DE}{EF} = \frac{l_2}{l_3 - l_2}.$$

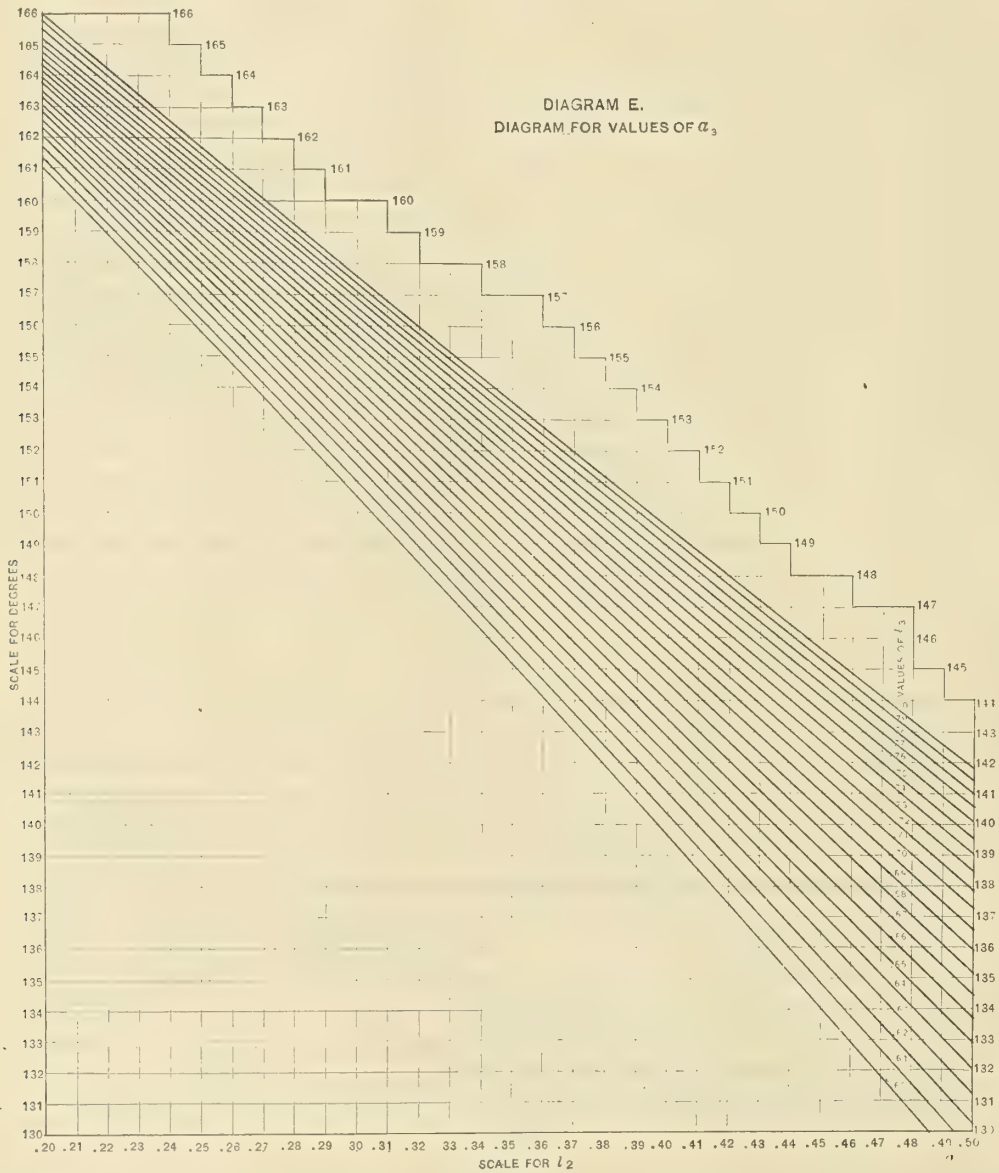
Evidently, then, if in drawing a primary force polygon, given w_4, l_4, l_3 and l_2, we determine the point E from the formula

$$\frac{OE}{OB} = \frac{l_4 - l_3}{l_3},$$

and then draw a line DF at any inclination through E, determine D and F from the formula $\frac{DE}{EF} = \frac{l_2}{l_3 - l_2}$, then join FO, DB, we have a closed primary force polygon for which the primary moment polygon is also closed. The primary moment polgon is given at once by drawing OC through O parallel to DF.

Since we can draw any number of lines, such as DF, we can determine any number of weights and angles giving primary balance for given lengths of engine, given forward reciprocating weight, and given position of the second and third cylinders. This being the case, we can impose another condition. For instance, we can so determine the angles and corresponding

DIAGRAM E.
DIAGRAM FOR VALUES OF α_3



weights as to get a desirable turning force, *i. e.*, the torque as uniform as possible during a revolution. Or we can determine weights and angles which reduce the secondary force to zero or *close* the secondary force polygon. This is readily done by trial and error. Assume a value and position of *DF* and draw the corresponding secondary force polygon. Guided by this, assume a second value and position of *DF*, for which the secondary force polygon is more nearly closed, and so on. I found in practice that after about three successive values of *DF* I could determine the value giving a closed secondary force polygon. It was in this way that I obtained data from which to plot the diagrams A to F, giving values of a_1, a_2, a_3, w_1, w_2 and w_3. These diagrams are practically correct. After they

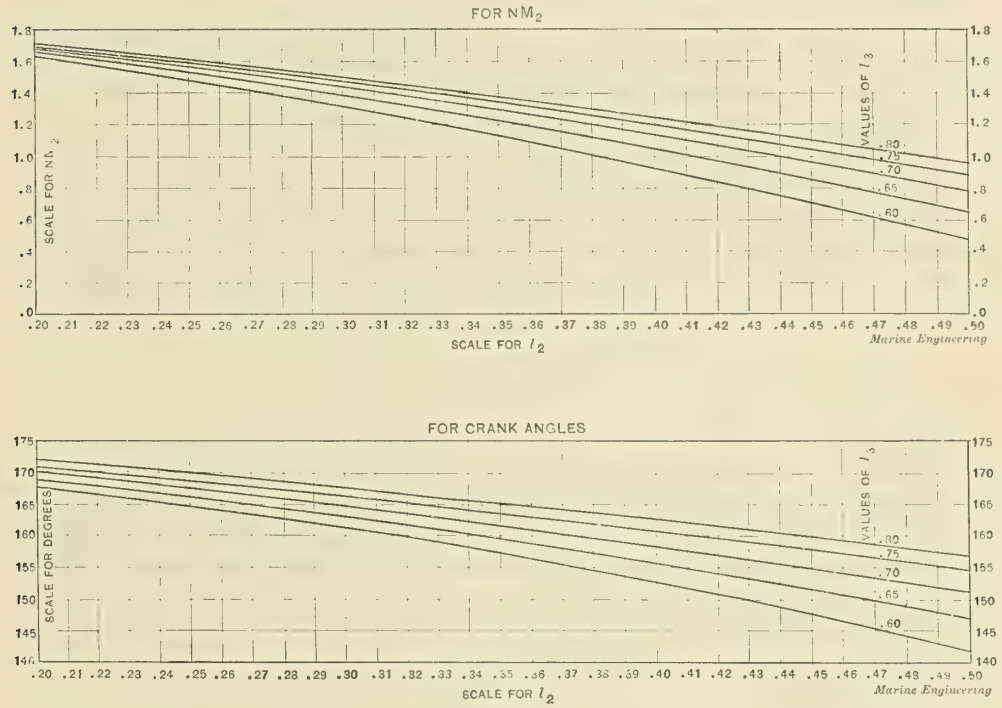
grams A, C and E give the first approximation to each crank angle, and hence to each eccentric angle since the angle of advance is known for each eccentric. From these draw the primary and secondary force and moment polygons of the valve gear. These will, in general, have resultants. Now determine new weights and angles for the main gears, such that they are not in balance but *balance* the valve gears. This is a second approximation. Continue the process until the results are practically exact. The process is comparatively short and simple, and gives substantially exact results.

SOME GENERAL CONCLUSIONS.

6. An inspection of the weight and angle diagrams shows that the weights for the middle or heavy cranks

DIAGRAM G.

DIAGRAM FOR RESIDUAL SECONDARY MOMENTS



were plotted and traced, I took off values of a_1, a_2, etc., for 35 values of l_2 and l_3 and *calculated* the resultants of primary and secondary force and moment polygons. The primary and secondary force and primary moment polygons were practically closed in every case. The results as regards the secondary moments are given in diagram G.

MODIFICATIONS NECESSARY BECAUSE OF VALVE GEARS, ETC.

5. The six weight and angle diagrams for the determination of a_1, a_2, a_3, w_1, w_2 and w_3, can, of course, be used for the main reciprocating weights only. When considering the valve gears and other secondary weights, additional work is necessary, which may be briefly outlined as follows:—

From the given cylinder locations determine the weight ratios. From the weight ratios determine the actual weights neglecting valve gears. The angle dia-

are apt to be nearly the same, while those for the end cranks differ materially and are lighter than either of the others. That is, if applied to quadruple engines, the high pressure and first medium pressure should be at the ends of the engine. The diagrams are drawn primarily for No. 1 cylinder aft, No. 4 forward, and the crank angles measured in the direction of rotation of the engine. It is quite permissible, however,

1. To lay off all crank angles opposite to the direction of rotation. This follows from the fact that a balanced engine is balanced for rotation either ahead or astern. To gain a better curve of torque it may be desirable to set off crank angles in one direction rather than the other.

2. To turn the engine bodily end for end. This will often be desirable in order to bring the lightest cylinder—the high pressure—at the forward end of the engine.

CHANGES AND AMENDMENTS IN THE RULES OF THE UNITED STATES BOARD OF SUPERVISING INSPECTORS OF STEAM VESSELS.

Approved by the Secretary of the Treasury and Published under date of February 7, 1902.

Note. The changed or new matter is designated by italics.

RULE II.

Section 6. (Last paragraph.)

But no flat surface shall be unsupported at a greater distance in any case than [16] *18* inches, * * *

Section 9. (New, at end of second paragraph, page 31, Rules).

Wrought iron tubes, however, may be used without being subjected to the tests required from tubes made of Bessemer, acid or basic open-hearth steel.

Section 26.

* * * *The bronze casing* of all fusible plugs, unless otherwise provided, shall have an external diameter *of* not less than that of a [1—] *three-quarters of an* inch gas or steam pipe screw tap, except when such plugs shall be used in the tubes of upright boilers, plugs may be used with an external diameter of not less than that of a three-eighths of an inch gas or steam pipe screw tap [said plugs to conform in construction with plugs now authorized to be used by this board]; and no such plugs shall be used unless the core of the plug is filled with good Banca tin from end to end of the bronze casing; and it shall be the duty of the inspectors to see that these plugs are *so* filled [with Banca tin] at each annual inspection.

The manufacturers of fusible plugs, whether boiler makers or others, shall stamp their name thereon for identification, and file with the local inspectors in the districts where their plugs are in most general use a certification stating that the fusible plugs manufactured by them are filled with good Banca tin, in the manner described in this section.

Section 38.

* * * All copper steam pipes shall be flanged *over or outward* to a depth of not less than [four times] *twice* the thickness of the material in the pipes, * * *

The flanges of all copper steam pipes over 3 inches in diameter shall be made of bronze or brass composition, shall be securely brazed *or riveted* to pipe, * * *

The terminal and intermediate joints of all wrought iron and homogeneous steel feed and steam pipes over 3 inches in diameter, other than on pipe or coil boilers or steam generators, shall be made of wrought iron, homogeneous steel, or flanges of equivalent material; and all such flanges shall have a depth through the bore of not less than that equal to one-half of the diameter of the pipe to which any such flange may be attached; and such bores shall taper slightly outwardly toward the face of the flanges; and the ends of such pipes shall be enlarged to fit the bore of the flanges, and they shall be substantially beaded *over or outward* into a recess in the face of each flange. * * *

All lap-welded iron or steel steam pipes over [5] *5½* inches in diameter or riveted wrought iron or steel *or seamless drawn steel* steam pipes over [5] *5½* inches in diameter, in addition to being expanded into tapered holes and substantially beaded into recess in face of flanges, shall be substantially and firmly riveted with good and substantial rivets through the hubs of such flanges; and no such hubs shall project from such flanges less than 2 inches in any case. *Provided, however, that when such pipes are double riveted into cast steel, wrought iron or homogeneous steel flanges, said flanges to be equal in strength to the strength of the pipe, the process of expanding and beading may be dispensed with. It is further provided that for pressures of 100 pounds and under said pipes may be single riveted to the flanges in lieu of double riveting. The joints of all flanges shall be made with a sufficient number of good and substantial bolts or rivets, to make such joints at least equal in strength to all other parts of the pipe.*

Section 39. (First and second paragraphs.)

39. All coil and pipe boilers hereafter made, when such boiler is completed and ready for inspection, must be subjected at *the first* inspection to a hydrostatic pressure double that of the steam pressure allowed in the certificate of inspection—to take effect on and after July 1, 1897.

The use of *malleable iron or* cast steel manifolds, tees, return bends or elbows in the construction of pipe generators shall be allowed, * * *

RULE V.

Section 2. (Fourteenth paragraph.)

Engineers of lake, bay and sound steamers who have actually performed the duties of engineers for a period of three years shall be entitled to examination for engineer of ocean steamers, applicant to be examined in the use of salt water, method employed in regulating the density of the water in boilers, the application of the hydrometer in determining the density of sea water, and the principle of constructing the instrument, and shall be granted such grade as the inspectors *having jurisdiction on the great lakes* may find him competent to fill.

RULE IX.

Section 1. (New, added to section.)

Local inspectors, in determining the distance between the flues and the shells of externally fired boilers, under provisions of section 4,434, Revised Statutes of the United States, shall take the measurements from the plate in the flue to the plate in the shell.

APPENDIX TO THE RULES.

(New. Added after last paragraph, page 83, Rules and Regulations of 1901.)

To determine the pitch of rivets from the above formulas use the diameter and area of the rivet holes. The diameter of the rivets as given in the following tables is the diameter of the driven rivet.

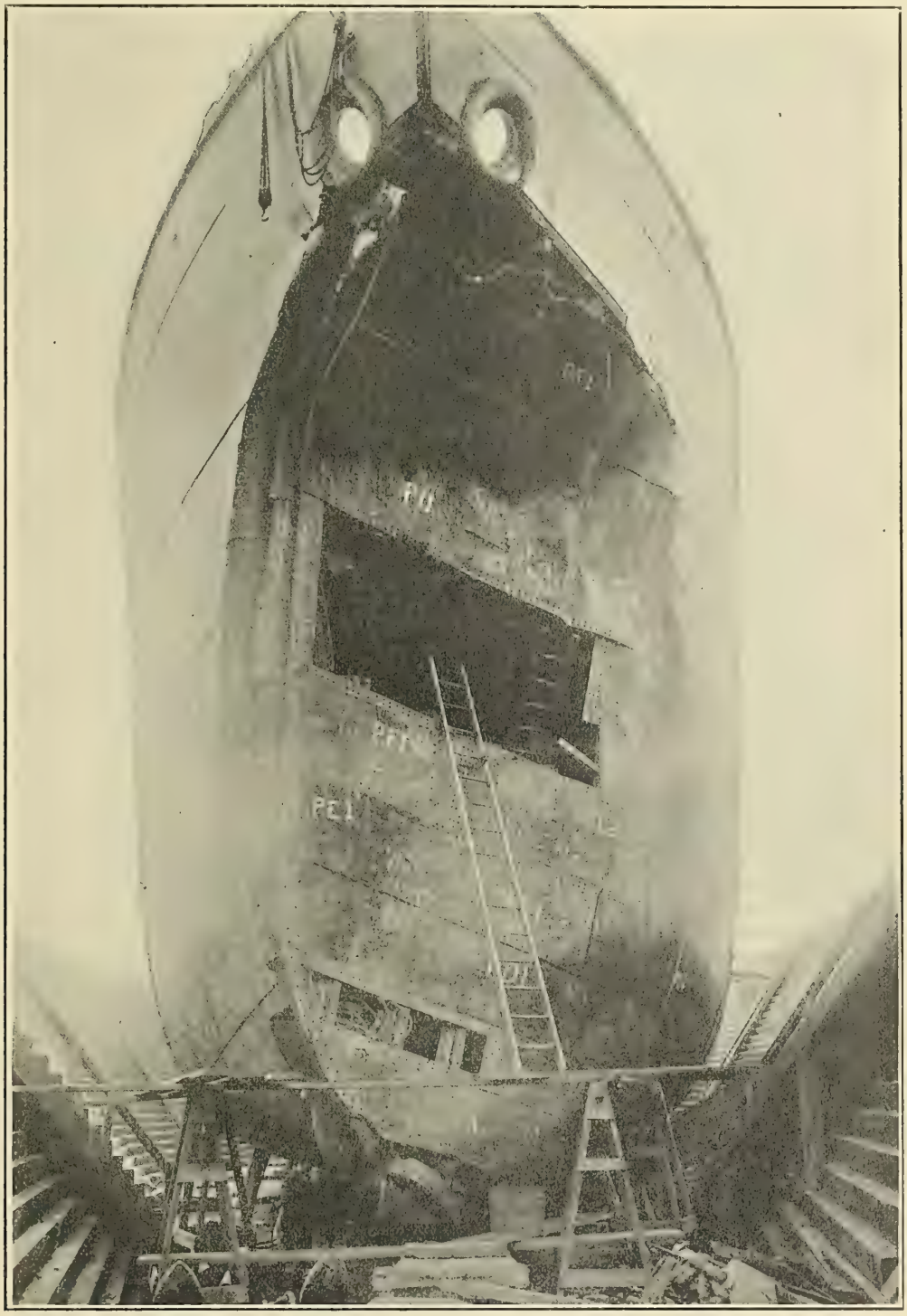
Any riveted joint will be allowed, when it is constructed so as to give an equal percentage of strength to that obtained by the use of the formula given.

Chicago Shipbuilding. — During the year 1901 there were built at Chicago, eight steel freight steamships of an aggregate tonnage of 21,178 tons and costing $1,895,000.

New Havana Drydock.—The Havana Drydock Company, of Havana, Cuba, has opened its new steel floating drydock. The length of the main box is 280 feet; width, 88 feet 2 inches; the additional riggers on each end are 40 feet in length, bringing the total length of the dock to 360 feet.

Replacing a Damaged Bow.

The accompanying illustrations show the bow of the steamer *Isle of Kent*, which, on the 14th of December, was in collision with the Spanish ship *Amesti* while



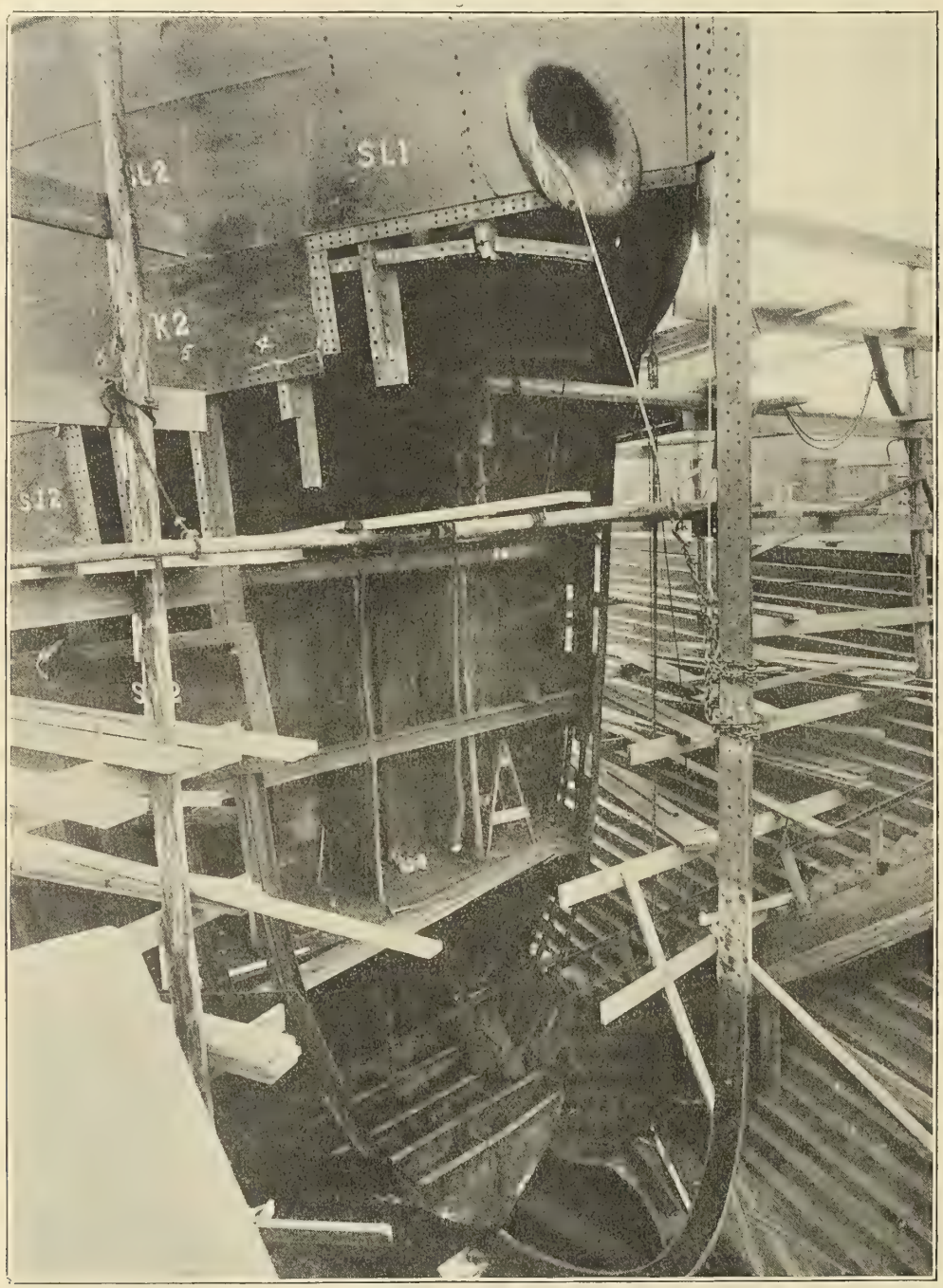
DAMAGE TO THE BOW OF A STEAMER AFTER COLLISION AT SEA.

350 miles east of Boston Light. The *Isle of Kent* struck the other ship bows-on on the starboard side and her stem was folded up in the manner shown in the first engraving. The *Amesti* sunk within 15 minutes, but her crew was saved. The collision bulkhead of the *Isle of Kent* saved this ship from going to the bottom. She proceeded to Boston and was docked and surveyed.

The contract was awarded the Fore River Ship and Engine Company, who agreed to complete the work within 25 days. Within three days from the signing of the contract the steel forging for the stem was

completed at the forge works of this company. This forging was in one piece 62 feet by 10 by 2 3-4 inches. The company's floating machine shop was towed from the plant at Quincy to the dry dock and their steam lighter was kept in service between these two points.

New Organization. — The American Shipmaster's Protective Association of sail vessels completed its organization in Newport News on January 30th, with Capt. H. H. Haines, of Taunton, Mass., president, and A. L. Crowley, of Boston, Mass., secretary. The



DAMAGED PLATES REMOVED AND NEW STEM FITTED.

The damaged bow plates and frames were first cut out by pneumatic tools and a new bow built on. The second illustration represents the hull made ready to receive the new material with the new stem in place. The work was completed within contract time, making a record job for quick repair.

headquarters of the organization will be in Boston, but branches will be established in every port on the Atlantic coast, with a legal representative in each. The object is to secure the repeal of laws adverse to the interests of masters and owners of sailing vessels, and obtain the enactment of other laws to their interests.

LAKE BUILT OCEAN TRAMP STEAMERS.

BY CHARLES C. WEST.

The advent of the American Ship Building Company into the field of the construction of ocean boats has been signalized by the fulfilment of orders for two steamers placed with them by the American Navigation Company, of New York. In the past quite a number of canal size ocean boats have been built on the Great Lakes, but in the *Minnetonka* and *Minnewaska* come the first real encroachment of the American Ship Building Company upon what has always been considered the rightful province of the coast shipbuilders.

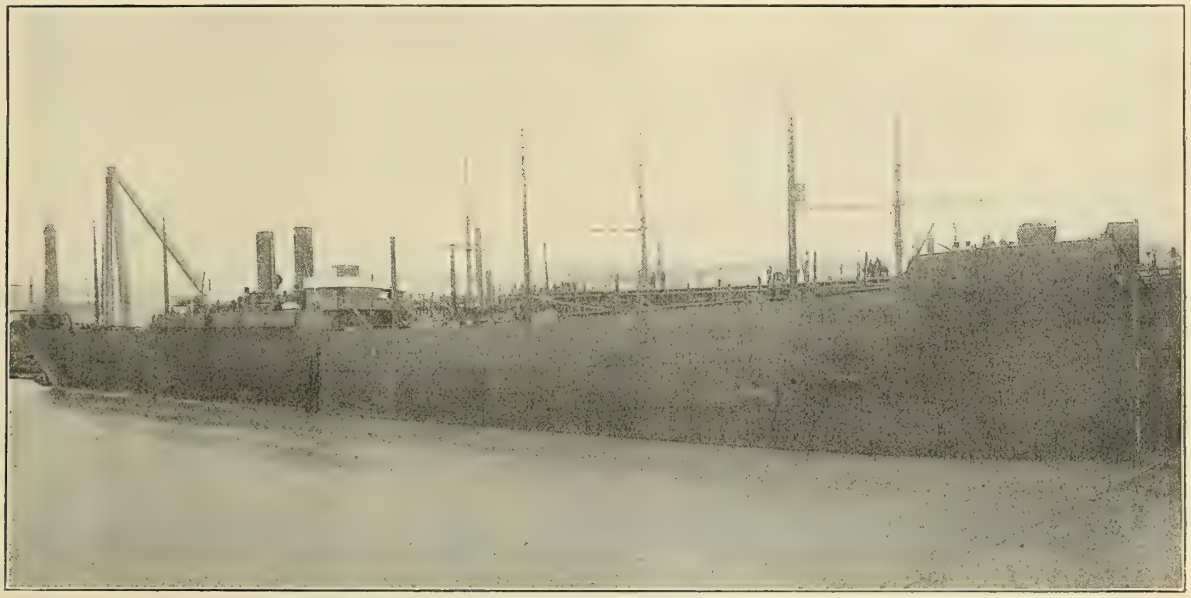
The capability of the fresh water builder has never been doubted, but natural disadvantages that restricted the size which could be taken to the salt water seemed to fully define his field. Therefore, the middle continent shipyards have gone on for years simply supplying the local demand for ships, but in the performance of this, as is well known, have developed original, effective and economical methods of construction. It is, therefore, with a confidence born of long experience that the American Ship Building Company enters upon this new field of operations.

The canals, which represent the only feasible waterway between the Great Lakes and the ocean, restrict the size of the boat bound for salt water to about 250 feet, and the demand for craft of this size being small, compelled the American Ship Building Company to adopt the plan of building ocean boats of large size, cutting them in two parts, taking them to the coast via the canal, and joining them in some dry dock near the mouth of the St. Lawrence. Notwithstanding the cost attendant upon such an operation the lake builders feel that they can compete successfully with the coast shipbuilders, and at the same time turn out a boat which would be in every respect the equal of the product of a coast yard.

In the construction of the ships which are to demonstrate the soundness of this belief, all lake precedents and methods of construction have been abandoned, and a standard type of ship has been evolved which differs in no radical way from the vessel put out by foreign or American ocean shipbuilders.

It might be thought that ships built and delivered in such a way would be designed with a view to the cutting process in order to reduce the attendant cost to a minimum, and the ship thereby weakened. Such an idea, however, is entirely erroneous, for with the exception of a limited use of snaphead rivets, which permit of easy removal, the ships were designed and built as though no such process were contemplated.

These boats are of the variety known as ocean tramps, having full lines forward but with an easy run aft to the propeller. A large proportion of dead flat permits of an effective use of the mold system which was inaugurated and perfected on the Great Lakes. The hull designs were made by the Hull Department of the American Ship Building Company, under the direction of Mr. A. C. Diericx and according to Lloyd's rules, and a special surveyor of that bureau, Mr. A. C. Heron, supervised the work of construction.



OCEAN STEAMER MINNETONKA BUILT AT CLEVELAND, OHIO.

The boats were designed pre-eminently as dividend-earners, and although the beauty feature was the last consideration it will be seen by the accompanying illustration that the designers were successful in producing a good looking and at the same time a well arranged craft. They were designed with a view to rapid and easy handling of cargo, and although no gangways are provided, this is recompensed for by the introduction of more than the usual number of hatches. Some of these are of large size to accommodate bulky freight, and are re-enforced by a removable strongback at the center. The cost of the ships to the owners is about $450,000 each.

The first of these ships, the *Minnetonka*, was success-

fully launched at the Globe yard of the American Ship Building Company, on September 14, 1901. She is a single screw steamer of 7,000 tons dead weight capacity at 24 feet draft of the following dimensions:—

Length between perpendiculars	430 ft. 0 in.
" over all	443 " 6 "
Breadth, molded	43 " 7½ "
Depth, molded to upper decks	33 " 0 "
Shear for'd	8 " 0 "
" aft	4 " 6 "
Cargo capacity	360,000 cu. ft.

The specifications are those required by Lloyds for 100 A rating, though in some cases even these requirements were exceeded.

The width of the locks of the Canadian canal restrict the molded beam of these boats to 43 feet 7 1-2 inches, and, while the depth of water over the sills of the locks is supposed to be 14 feet, at certain seasons of the year vessels drawing more than 12 feet 6 inches are unable to pass. Therefore, the designers of these boats were forced to bring the maximum depth of either of the two parts well within this limit.

There are three decks, the two upper ones being laid continuously, cut only for hatches, and the lowest having a wide stringer plate laid upon it.

The bulkheads are especially heavy and are secured to the shell by double angles.

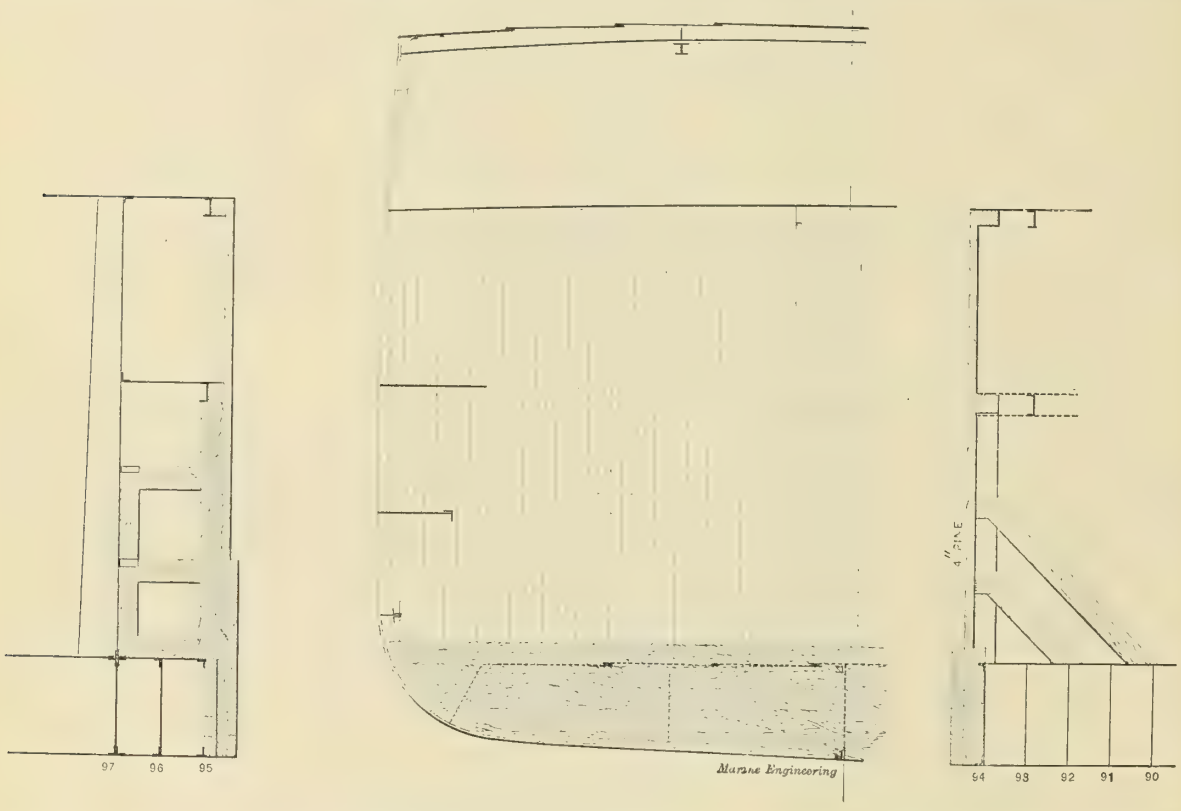
The keel is of the flat plate type 20-20 thick and treble riveted, the after end having the usual box plate formation to receive the stern post. The stem and stern post are of the best hammered scrap iron, the latter having gudgeons and stoppers wrought on.

A center continuous plate keelson, which ends at the tank top, divides the water bottom into two sections, which are in turn subdivided by watertight floors under each bulkhead.

The water bottom which extends the entire length of the ship has a capacity of 1,340 tons, and is provided with air and sounding pipes at the forward and after end of each compartment. Fore and aft peak tanks are provided having a capacity of 90 and 70 tons respectively.

The water bottom compartments under the engine and boiler spaces and for twenty-six frame spaces aft of that are used as fresh water tanks.

There are eight watertight bulkheads, all of which extend to the spar deck. The bulkheads are not cut, with the exception of the one between the engine-room and the after hold, which has a guillotine door into the shaft tunnel.



TEMPORARY WOODEN BULKHEAD FITTED FOR TOWING THE FOREBODY OF THE MINNETONKA THROUGH THE CANALS.

It will be seen by the longitudinal section that the bulkhead just forward of the boiler space extends on frame No. 97, from the tank top to the main deck, and from the main to the spar deck on frame No. 91. This was done to provide for an auxiliary coal bunker below the main deck, and to better divide the space between decks.

The deck erections consist of a steering house aft, located on the fantail, a bridge house and a forecastle. On the spar deck in the forecastle are placed the firemen's and seamen's messes, while on a deck directly below are located their respective quarters. The quarters of the rest of the crew, together with the officers' are in the bridge house. Above the bridge house are the captain's quarters, wheelhouse and bridge.

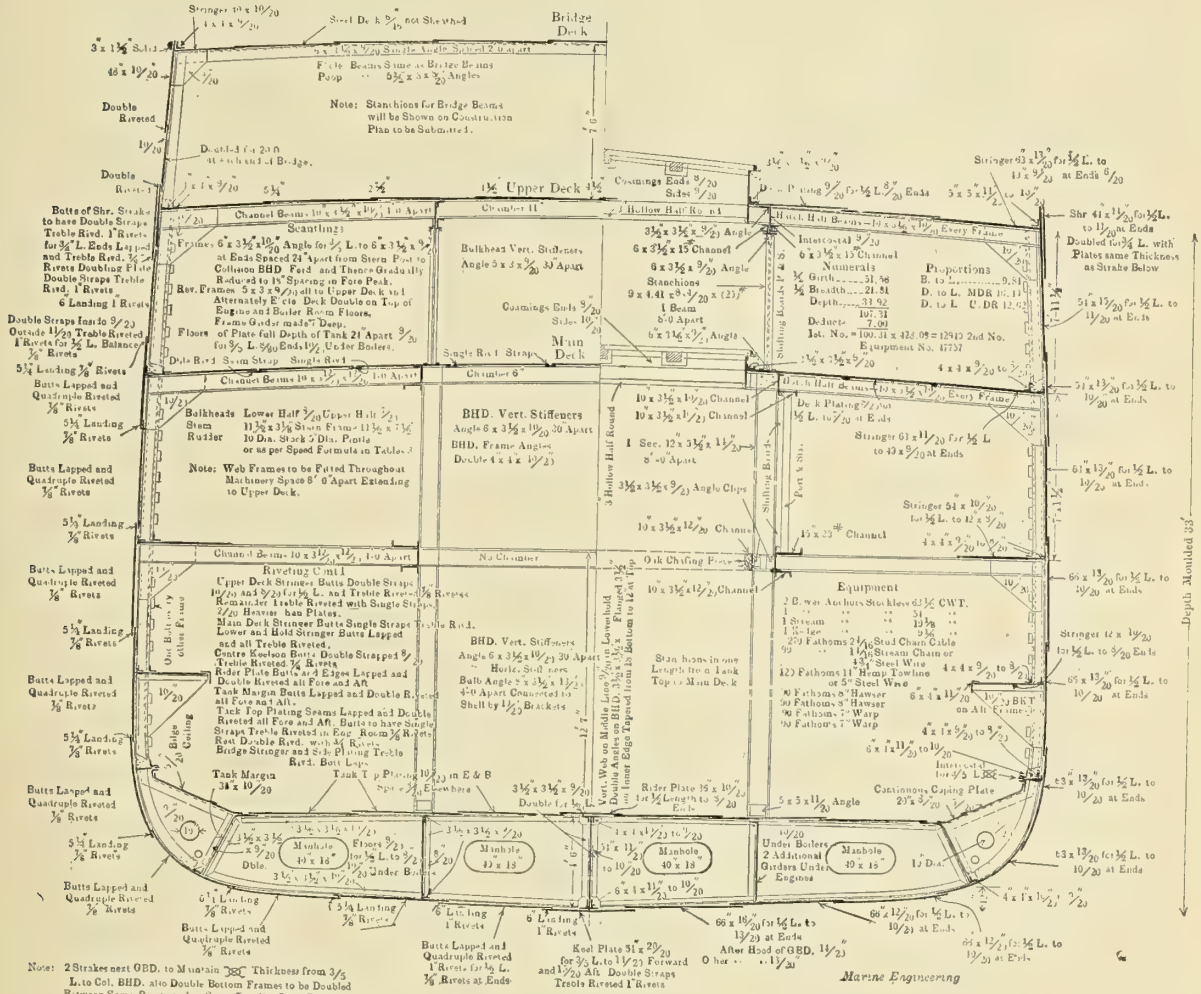
The work of loading and unloading these ships can

be carried on with exceptional facility, since two cargo booms are arranged over each hatch. The four regular masts each carry four booms, and two derrick masts are provided for hatch No. 5.

The coal bunkers are filled by means of two hatches situated just forward and aft of the stacks on the top of the bridge house, while a small hatch is arranged on the starboard side for the bunker of the donkey boiler. The ventilation of the hold is effected by bell mouth ventilators on the spar deck.

The propulsive equipment of these ships, which was designed by the Engine Department, under the direction of Mr. A. P. Rankin, consists of one 3-crank, 3-cylinder vertical inverted triple expansion engine, having cylinders 27 inches, 42 1-2 inches and 73 inches in diameter by 48 inches stroke. It was designed to give 2,400 indicated horse power at 70 revolutions per minute. This, it is estimated, will give the ship a loaded speed of 10 1-2 knots.

The arrangement of the cylinders from forward aft



MIDSHIP SECTION OF THE LAKE BUILT TRAMP STEAMERS.

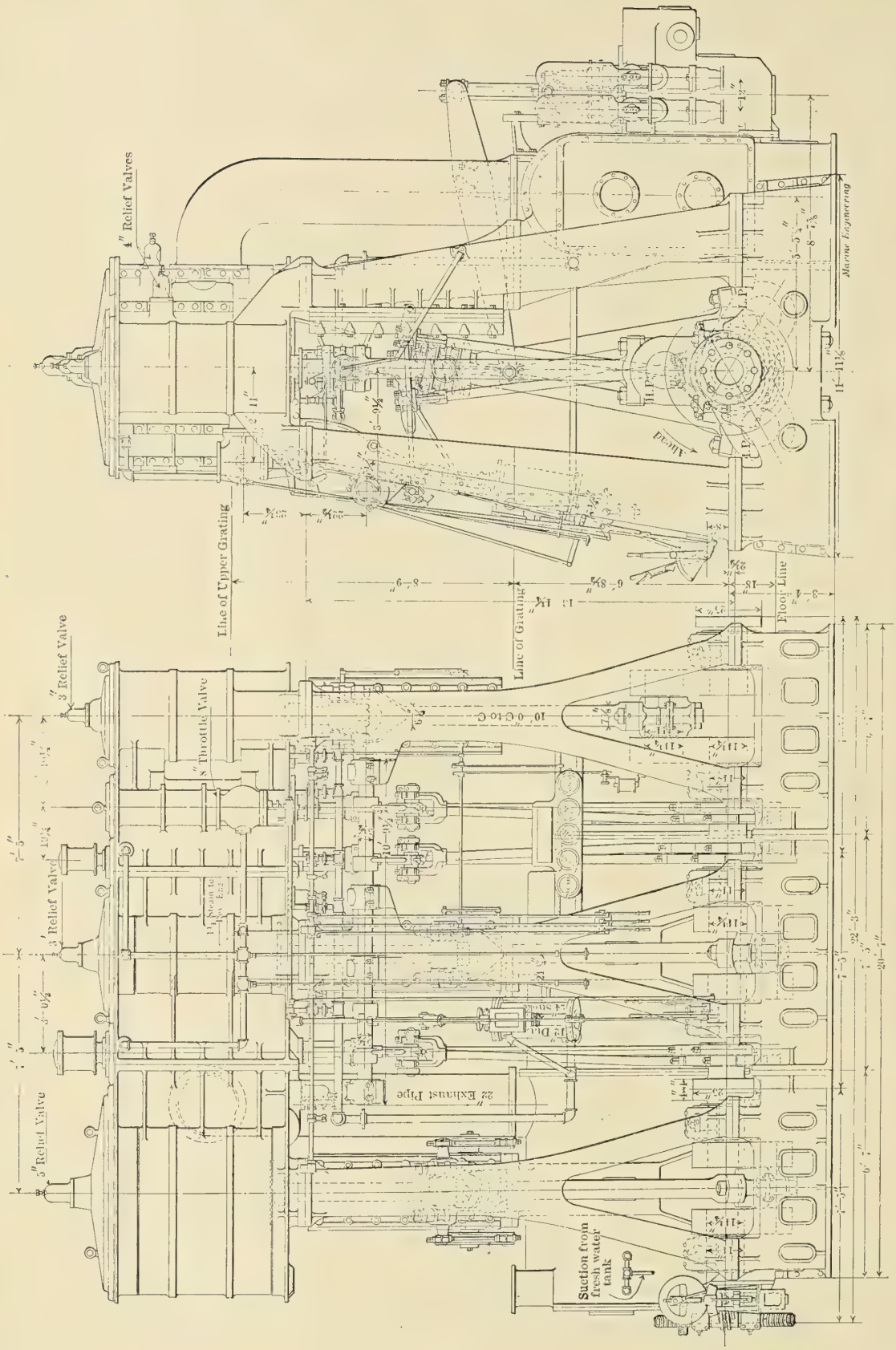
The rudder is of wrought iron frame with steel cover plates, and has the rudder stock carried above the spar deck where the quadrant is placed. The steering is located in the after projection of the bridge house on the spar deck, and is connected to the quadrant by jointed bars, which lead directly along the deck to the quadrant in the steering house aft. Coupled directly to the rudder stock also is a screw steerer placed above the quadrant. The steering engine is connected to the wheelhouse by shafting and bevel gears.

The ships have four steel masts, to each of which is fitted a triangular sail, the foremast being also provided with a foresail.

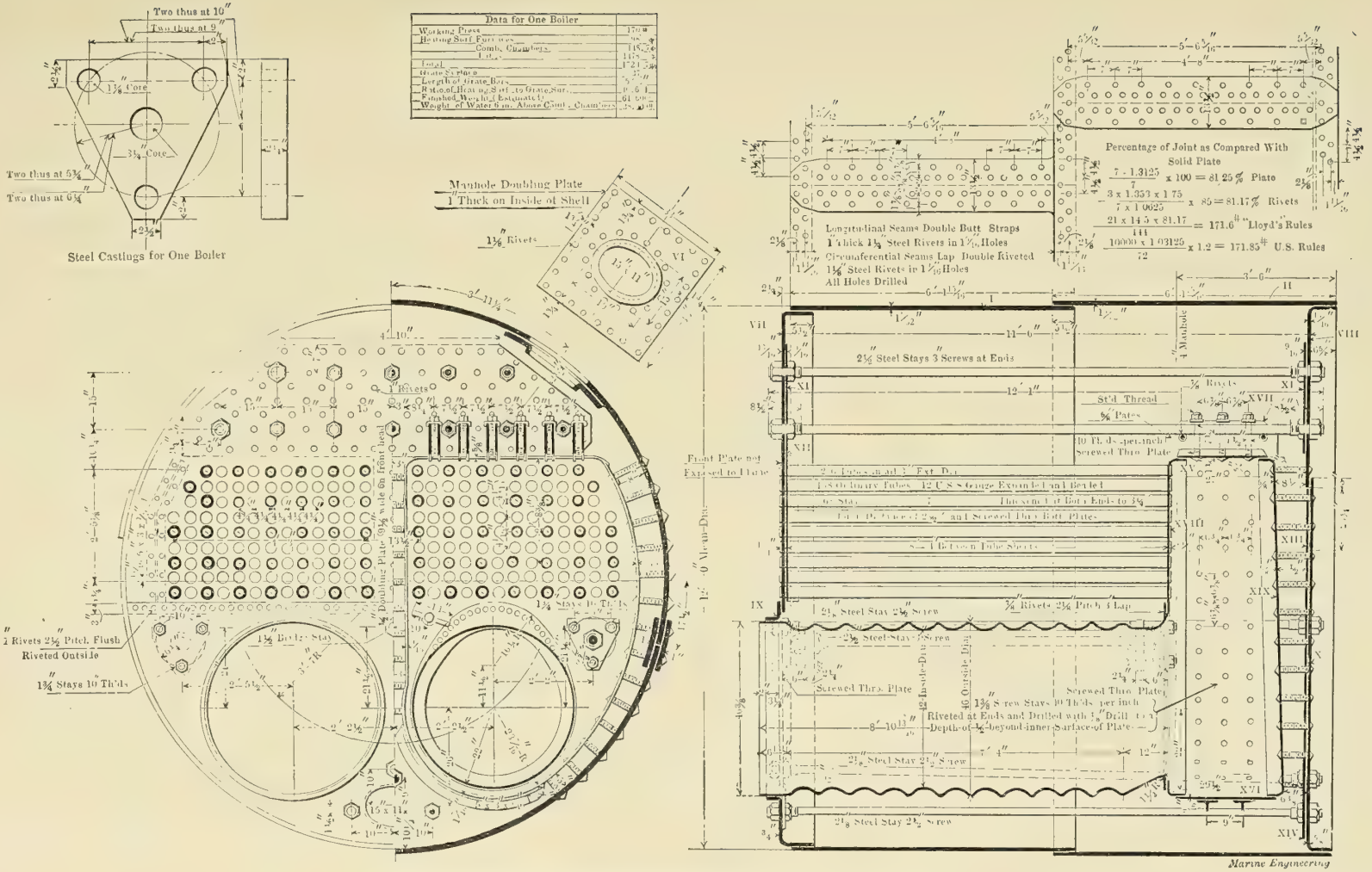
is high, intermediate and low. These are supported by six cast iron columns of box section. On the starboard side they are all bolted directly to the engine bed, but on the port side the two after ones are bolted to the top of the condenser.

The bed plate, which is of the three section box type, rests directly on the tank top, the longitudinals of the hull being arranged to take its holding down bolts. The condenser is of the rectangular ribbed pattern, and contains 3,150 square feet of cooling surface.

The valve of the high pressure cylinder is of the piston type, and that of the intermediate pressure is a double ported slide, and both are located between



TRIPLE EXPANSION ENGINES FOR THE LAKE BUILT STEAMERS MINNETONKA AND MINNEWASKA.


Two thus at 10″
Two thus at 9″
1⅛″ Core
3¼″ Core
Two thus at 5¾″
Two thus at 6¼″
Steel Castings for One Boiler
Data for One Boiler
Working Press.
Heating Surf. Furnaces
Comb. Chambers
Total
Grate Surface
Length of Grate Bars
Ratio of Heating Surf. to Grate Surf.
Finished Weight, Estimated
Weight of Water 6 in. Above Comb. Chambers
Manhole Doubling Plate
1 Thick on Inside of Shell
1⅛″ Rivets
Percentage of Joint as Compared With Solid Plate
Longitudinal Seams Double Butt Straps
1″ Thick 1⅛″ Steel Rivets in 1 1/16″ Holes
Circumferential Seams Lap Double Riveted
1⅛″ Steel Rivets in 1 1/16″ Holes
All Holes Drilled
2½″ Steel Stays 3 Screws at Ends
Std Thread
⅝″ Plates
Front Plate not Exposed to Flame
Screwed Thru Plate
Screwed Thru Plate
1⅜″ Screw Stays 10 Th'ds per inch
Riveted at Ends and Drilled with ⅞″ Drill
Depth of ½ beyond inner Surface of Plate
2⅞″ Steel Stay 2½″ Screw
2⅛″ Steel Stay 2½″ Screw
¾″ Rivets 2¾″ Pitch 4 Lap
2½″ Steel Stay 2½″ Screw
1″ Rivets 2½″ Pitch, Flush Riveted Outside
1¾″ Stays 10″ Th'ds
1½″ Boiler Stay
1″ Rivets
Marine Engineering

SCOTCH BOILERS OF THE STEAMERS MINNETONKA AND MINNEWASKA.

the high pressure and intermediate pressure cylinders. The low pressure cylinder has a double ported flat valve located between the intermediate pressure and low pressure. These valves are all worked by a double bar Stephenson link motion.

The piston rods are of forged steel, having conical single thickness cast steel pistons. The crank shaft is of the built-up interchangeable type, consisting of Bethlehem steel forgings, having pins and shafts shrunk into the webs.

The crank and thrust shafts are 14 inches in diameter, joining to 13 1-4 inch tunnel shafting which terminates in a 15 1-4 inch propeller shaft.

The thrust bearing is of the horseshoe type, having eight collars on the shaft, 21 inches outside diameter.

The stern tube is cast iron, and extends from the after peak bulkhead through the stern post, terminating in a lignum vitae bearing. The propeller shaft is covered with a continuous brass liner.

The propeller is of the four bladed sectional type, with cast iron hub and blades, being 18 feet 6 inches in diameter, 17 feet pitch, and having 94 square feet of surface.

The main engine is provided with a steam turning gear on its after end, and a reversing engine bolted to its middle column on the starboard side.

There are two feed pumps, two bilge pumps and one air pump worked from the main engine, and in addition one high pressure Blake upright feed pump, one duplex donkey pump, one duplex ballast pump and one hand "Downton" pump.

A Worthington feed water heater is fitted, into which the feed water is sprayed by the attached feed pumps, and from which the independent pump takes its suction.

The battery of boilers consists of four Scotch boilers, 11 feet 6 inches long and 12 feet in diameter, each having 1,725 square feet of heating surface and 40 square feet of grate surface for each boiler. The boilers work at a pressure of 170 pounds per square inch. In addition to the main battery of boilers a donkey boiler is provided, placed on a special platform between the stacks, which has 115 pounds pressure, 40 square feet of grate surface and 1,200 square feet of heating surface.

The main steam pipe is 9 inches in diameter, and composed of extra heavy lap welded iron pipe.

The connections to the boilers are made with heavy copper pipe, having suitable expansion bends.

The Howden hot draft is used and produced by an 84-inch fan, which is in turn worked by an 8-inch by 8-inch engine. There is a bunker capacity of 800 tons in the side bunkers, and a capacity of 540 tons in an auxiliary bunker in the forward hold.

In the engine-room is installed an evaporator having a capacity of 12 tons each twenty-four hours.

The electrical equipment consists of two direct connected 10 kilowatt capacity machines, operated by vertical engines.

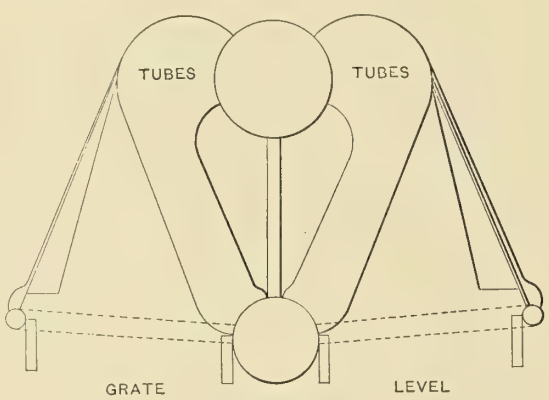
As soon as navigation opens in the spring these boats will be cut just forward of the boiler-room bulkhead, and the forward portions fitted with wooden bulkheads as shown in the illustration. Then the two portions will be towed to Montreal, there docked and connected.

Dory Launches.— Gasoline engines are being fitted into fishermen's dories at Fall River, Mass. These boats can be built at a much less figure than the ordinary launch and the equipment is satisfactory to many owners.

Monthly Shipbuilding Returns.—The Bureau of Navigation reports 74 vessels of 22,796 gross tons built in the United States and officially numbered during the month of January, 1902. The largest steel steam vessels included in these figures are the *El Alba* of 4,614 gross tons, built for the Southern Pacific Company, at Newport News, Va., and the *Spokane*, of 2,036 gross tons, built at San Francisco, Cal., for the Pacific Coast Company.

PRACTICAL POINTS IN THE ERECTION OF THE THORNYCROFT BOILER.

The Thornycroft boiler has been in use for several years for small boats, torpedo boats, yachts, etc.; but it is only recently that it has been considered as adapted for use in large vessels. A number of vessels are being built in our country in which this boiler will be installed, vessels as large as ten thousand tons displacement. The first form of this boiler had one central steam drum above and two side water drums below, between which latter was placed the grate. A slight variation of this for several boilers built in batteries omitted one lower water drum between adjacent boilers. The "Daring" type, Fig. 1, permits the combination of several boilers with a reduction in weight, space, and first cost. This type is so called from having first been used in H. M. S. *Daring*. This form has one large steam drum, one water drum directly beneath and between two grates, while on a level with and outside these grates are two horizontal pipes which play the parts of small water drums.



DARING TYPE.

Fig. 1 *Marine Engineering*

A further variation of this last type, as shown in Fig. 4, is a boiler with one central steam drum above and three water drums below, with two grates between them. These water drums are of equal size and about half the size of the steam drum. This arrangement, though heavier, permits of a large number of tubes from the outside water drums to the steam drum, and thus increases the steaming capacity of the boiler for equal weights.

The "Daring" type has a number, eight or ten, down-comer pipes to conduct the water from the steam drum to the water drum below. In the new type these pipes are used in some cases for the central drum, while large down-comers attached to the underside of the steam drum near the end lead down to the ends of the wing water drums. In another form the many down-comer pipes to the central water drum are dispensed with and a three-way "Y" casting is used with three pipes, one leading to each water drum. The description, manufacture and erection of these last types will be here given.

The steel steam and water drums are made cylindrical with hemispherical heads and all joints welded. In one head is the manhole with the edge turned in to

form the joint and to reinforce or strengthen the head. The holes are central in the heads. The drums are of mild steel and they are carefully examined for flaws, pits, holes, bad welding, thin places, or variation of curvature. They are cleaned, scraped and rubbed with heavy mineral oil and kept in a dry place till wanted.

The curved tubes are seamless, cold-drawn steel. They may be ordered bent to template. They are carefully examined for splits, pits, and uneven thickness.

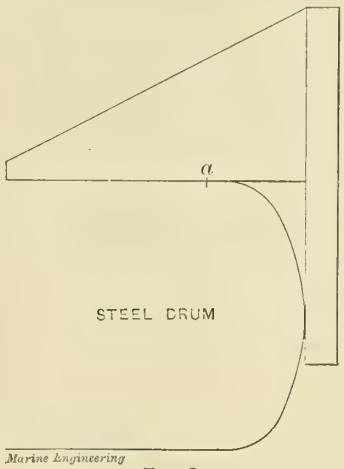


Fig. 2

In this last a slight variation is allowed, as seamless-drawn tubes are practically always slightly eccentric. A tube may have a fine hair line running lengthwise and this may indicate a sliver or split. Such a tube should be rejected.

The steel castings for the down-comer (see Fig. 5) are pickled in a solution of 5 per cent sulphuric acid, as are also the drums, before inspection. The castings should be smooth, of nearly uniform thickness, free

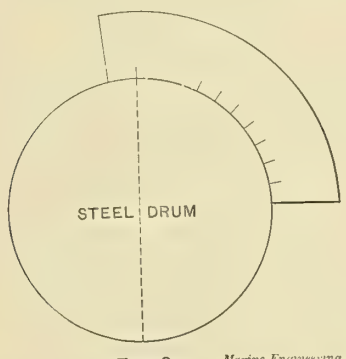


Fig. 3

from scars, holes, cracks, and of such dimensions that when machined they will be of the required size. The down-comer pipes are seamless drawn steel, free from pits, cracks, grooves, or deep blisters. The minimum thickness should be as great as that required. These pipes are pickled before examination. The flanges for these pipes are of cast steel and of such dimensions as to admit of machining to required measurements. The work of machining progresses upon several pieces at the same time.

The drums are placed in a convenient position and the holes for the small tubes are laid off. This is most easily and accurately done by centering the drum in position in a multiple drill press where it rests as in a lathe, supported by large cast iron dogs. The longitudinal welded seam is to come on top in the steam drum and on the bottom in the water drum. Full sized vertical sectional drawings are made of the boiler on a smooth floor. A template taken from this drawing showing the positions of the holes with regard to the center lines may now be applied to the drums and the lines of centers of tube holes marked off with great accuracy. A large wooden square, Fig. 2, is used to mark the position of the first holes by being placed tangent to the drum head in the drawing and then applied to the drum itself. This gives the distance of the first circumferential row from the end. A template, Fig. 3, in the form of an arc of a circle and of the diameter of the outside of the drum is laid on the drawing and the distances of the lines of centers of the holes are marked off from the center line of the drum. The intersection of these longitudinal lines and the circumferential lines as marked off by the square are the centers of the tube holes. These lines should be proved before drilling.

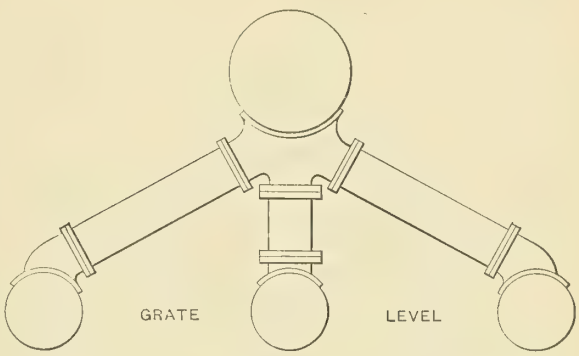


Fig. 4

A bar guide is strapped on the drum so that the first hole in the guide comes over the first tube hole position. This guide is a steel bar with one row of holes carefully laid off with distance between centers the same as between tube hole centers and with holes sufficiently large to receive steel thimbles which guide the twist drills, making holes of exactly the dimensions and distance apart required. The guide is secured firmly to the drum by two heavy iron straps around the drum. The holes should be drilled one thirty-second of an inch, smaller than full size and then reamed to the full size. It has been found that when drilled at once to the full size the surfaces of the holes are apt to be rough and grooved, especially in the steam drum which is thicker than the water drums. The line of centers of the next row of tubes is carefully laid off from the template, the drum turned and the guide bar shifted. After drilling it is better not to ream the holes till just before inserting the tubes, in order to avoid the rusting which would prevent making a tight joint.

An iron template for each different shape of tube is made from the drawing and the tubes are carefully compared with these. Most of them will require a slight bending, but those that require much should be

returned and bent again. The tubes when properly bent should not deviate from the templates more than one-eighth of an inch. The ends which fit into the drums should be accurate, for if a tube enters its hole at even a slight angle it is difficult to make a good joint. The tube ends are smoothed with emery cloth and a die driven over them to see that they are of exact size.

The holes are cut in the drums for the stops, feeds, down-comers, blows, water-gauges and safety valves,

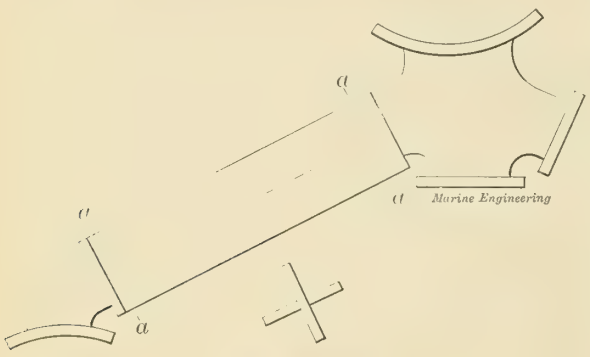


FIG. 5 AND 6.

and their positions are carefully laid off from templates taken from the full sized drawing. The surfaces of the drum around the holes are filed smooth and as cylindrical as possible.

The drums are now put into position on heavy wooden timbers and secured, steel angle distance pieces being used to hold them in relative position. The down-comer castings are then fitted.

These castings have been machined. The flange which fits against the drum has been turned off in a large boring mill and the flanges for the pipe connections in a lathe or small boring mill. The drum flange is then spot faced against the drum to a very close fit. They are then put on their respective drums and tem-

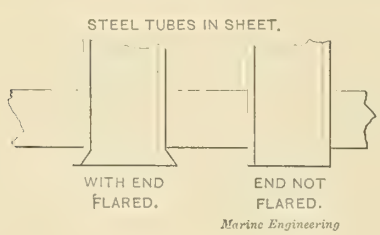


FIG. 7.

porarily bolted. It is better to not turn the pipe flanges till after the castings are bolted and fitted on the drums and these flanges can be laid off so that their surfaces are truly parallel.

To do this fit a one-half inch pine board, Fig. 5, neatly between the flanges, mark the edges of the pipe holes, find the centers on the ends of the board and draw a line through them. This will be the axis of the connecting pipe. Remove the board and fit a strip on either side wide enough to come to the edge of the flange and on the surface through line of axis. See Fig. 6. Then on the four edges of this template scribe lines in a plane perpendicular to the axis and one inch from the ends *a a*. Fit the template again snugly between the flanges and lay off along each edge a certain distance from the scribed lines. This certain distance is so taken that the least amount of metal will have to be turned off to make the pipe flange surfaces truly parallel. These four points on each flange are marked with a center punch. This operation is carried out for each down comer. The castings may now be removed and the pipe flange surfaces turned off. Marks should be made on the edge of drum flange and drum so that the casting may be accurately replaced. These castings are then riveted to their respective drums.

The boiler may be completed and tested with water pressure in the shop, in which case it is necessary to remove it bodily to and into the ship, leaving an opening in the decks large enough to allow it to pass below. Or, it may be completed in the ship, tested, and afterwards lowered on to the supports. The cold water test pressure is one and one-half times the highest working steam pressure, and it is maintained till every part of the boiler has been carefully examined. No leaks should develop, but should there be a slight weeping its importance must be judged by the inspector.

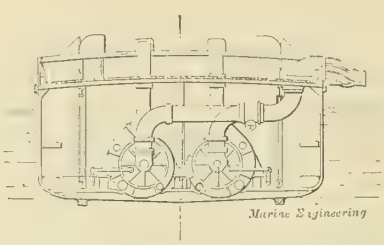
In fitting the small curved tubes in place care should be taken to have them fit accurately, not to expand them too much, and to use an abrupt taper pin to give a flare at the ends to prevent them crawling out; this taper may be one in four in diameter. They should project about one-quarter of an inch inside the drums, as shown in Fig. 7.

The fitting of the valves, the baffle plates and feed-water regulator present no difficulties outside of the usual mechanical fittings.

The casing with furnace fronts, doors, fire extinguishers and other attachments are fitted separately before being put in place over the boiler.

Dredges for Service on the Lower Seine.

The accompanying engravings are of a suction hopper dredge recently completed by the Societé Anonyme des Anciens Etablissements Satre Lyons Arles. The

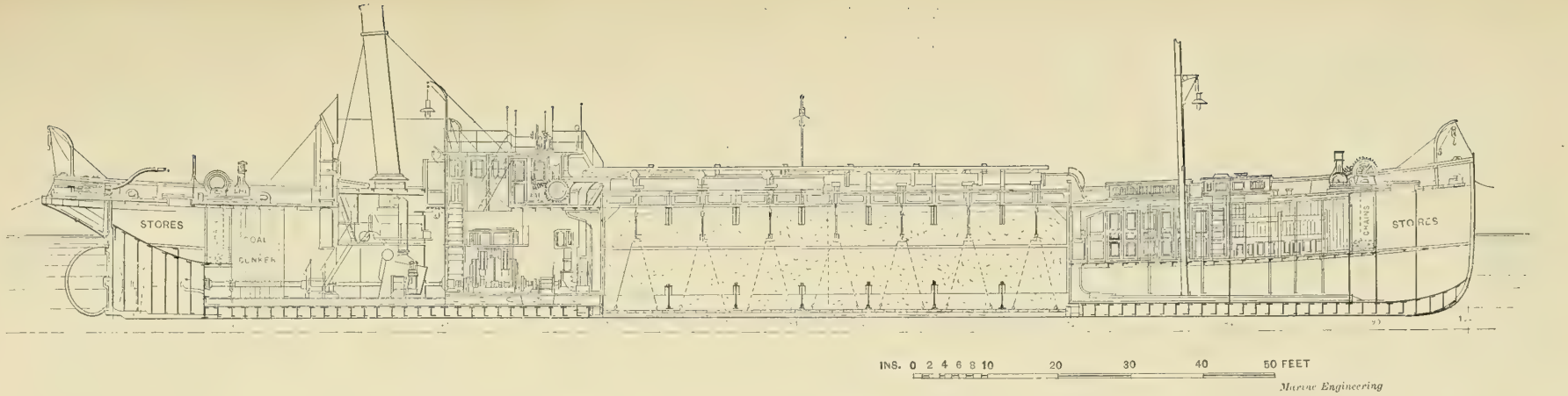


SECTION THROUGH THE ENGINE ROOM.

engravings and the following photos have been taken from *London Engineering*.

Because of shallow water in the lower Seine, navigation of the river has been restricted to vessels of light draft. It was the purpose to deepen the channel so that the larger vessels might ascend the river.

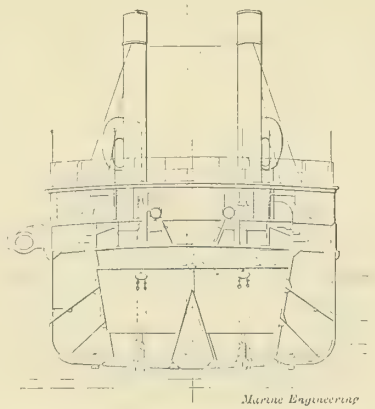
In 1895 a powerful bucket dredge was put in service, and it was found to be so efficient that further dredges



LONGITUDINAL OF SUCTION HOPPER DREDGE FOR SERVICE ON THE LOWER SEINE.

have been built. Much rough weather is encountered on the lower Seine, and, therefore, the newer dredges are constructed to operate in the seaway. The hull is divided into compartments by eight watertight bulkheads. The first compartment is the forepeak, the second is the crew space with berths for eight men, the third contains officers' cabins and one for the inspecting engineer. In the adjoining compartments are the sand and mud wells with a normal capacity of 17,658 cubic feet and a maximum capacity of 20,483 cubic feet, when extension tops are put round the openings of the hoppers. There are seven wells fitted with two pairs of doors or sluices. In the next compartment are located the engine and dredger pumps; in the adjoining one is the stokehole, and the aft compartment is used for a chain locker.

There are two sets of compound surface condensing engines with cylinders 17 5-16 and 31 1-2 inches diameter by 17 11-16 inches stroke, which develop 520 horse power with 150 revolutions. Steam is supplied by Belleville boilers, and there is a fresh water tank of capacity to supply the boilers for 75 hours. These engines can be connected to run either together or separately the two propellers or both the pumps. The pumps are centrifugal pattern, with shells cast in one piece, and provided with manholes for removing all obstacles. The suction pipe can draw sand from a depth



MIDSHIP SECTION THROUGH THE HOPPERS.

of 43 feet below water level, and can work during a rolling swell of 19 inches. The suction pipe is carried out on the starboard side, where it is connected by a universal joint to the direct pipe. The discharge from the pumps is through shutes, each with seven openings provided with sluices or doors to regulate the delivery. Double steam winches are placed on deck at both ends. Electric generators supply current for incandescent lights, and also three arc lamps are on deck.

The requirements of these dredges, which have been fulfilled, are, that they were able to draw 17,658 cubic feet of sand in fifty minutes, their traveling speed in a rolling swell of 15 inches being 8 knots, the coal consumed, 1.80 pound per indicated horse power per hour. The actual results of the test were, the hoppers were filled in thirty-eight minutes, a speed of 8 1-2 knots was reached, and the coal consumed was only 1.70 pounds.

Examination for Chief Engineer. — The United States Civil Commissioner announces that on March 25th and 26th examinations will be held at cities throughout the United States for the position of chief engineer, Class 3 in the Coast and Geodetic Survey. Persons desiring to compete should apply at once to the Commission, Washington, D. C., for application form number 304, and special forms.

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Changes to be made in copy, or in orders for advertisements, must be in our hands not later than the 15th of the month, to insure the carrying out of such instructions in the issue of the month following.

IN our last issue notice was taken of some of the questions which the marine engineer might ask himself in taking a broad survey over his field of activity. The points there noted related to the problem of the economical development of the power for the propulsion of the ship.

There are, however, many other parts of the field which will equally well repay his close attention. Thus he may note that beyond the problem of the economical development of power there lies the no less important one of its economical application to the propulsion of the ship. Here again it is a history of losses from engine to thrust bearing, where the push from the propeller is finally applied. Most of the loss is found in the propeller. Can this be reduced, and if so, to what extent? Is there likely to arise any propulsive device which shall be able to displace the propeller, and if so, what can it be? Is our present knowledge of the propeller final, or does it admit of any further improvement of moment? Again, what of the possibilities of more than one propeller on the same shaft as with steam turbine installations and what of the steam turbine itself as a rival to the steam engine? What of the efforts which are being made to perfect the balancing of the accepted type of reciprocating engine, and will their success or failure have any appreciable effect on the introduction of the turbine with its perfectly balanced running parts?

But it is not enough to study the economical development and use of power from the standpoint of the amount of fuel required per unit utilized for the propulsion of the vessel. There is an urgency equally strong toward economy in space occupied and in weight. Every extra or unnecessary ton which the machinery weighs displaces a ton of paying freight, and it must unfortunately be carried constantly about to the increase in the cost of fuel and general expense of operation. To what extent then will it be found possible to decrease the weights of machinery as at present in vogue without at the same time decreasing the margin of safety which experience demands? Will new materials be developed, will existing materials be improved, or will new combinations of old materials be found which will make possible improvements of this character?

Again, the materials which we employ are sometimes subject to waste and corrosion which seem often to be beyond our understanding or control. Likewise, the margin of safety which we deem sufficient does not always justify our judgment. Shall we learn better how to protect our materials of engineering construction from corrosion, or shall we discover new materials not subject to such chemical action, and shall we be able to better understand the play of the forces with which we have to deal and thus make our margin of safety just what is needed, but no more?

It is very sure that in the years of the present century great advances will be made in marine engineering, as in all other branches of human activity. It is safe to prophesy this, but in what directions will this progress be made? Along which of the lines mentioned above will the most notable progress be made, or will the route perchance take some direction which shall sweep aside our whole clumsy apparatus of steam boiler and engine and replace it with some more direct method of transforming energy from a natural source into mechanical work? These and all like questions the advancing years alone can answer.

THERE has been appearing in the Saturday issue of the Philadelphia Record a notable series of articles by public men on public questions. A recent paper in this series is by Rear Admiral George W. Melville, on *Naval Development During the Next Decade.*

The paper is one of strength and vigor as we should expect from the source, and we would strongly commend its careful perusal to all who are interested in these questions—we might better say to all who can read, for those who are not interested in these questions ought to be, and this article is well calculated to awaken such interest where it is lacking.

The author rehearses forcibly and clearly the general considerations which demand a navy adequate to our present needs and growing importance, and gives a statement of the various forces, educational, social and industrial, which are tending to unify our people on this point.

Taking up certain technical points Admiral Melville comes out boldly for a decrease in caliber of the heavy gun on battle ships. He is of the opinion that the ten inch gun is preferable, that the modern high powered ten inch gun having greater muzzle energy than the twelve inch of a few years ago possesses all the power which should be given to that particular part of the armament, and that the saving of weight can best be utilized by giving it to armor and to the remainder of the battery.

This recommendation is quite in agreement with the thought of many who are studying the question of naval armament, and is, furthermore, in the direct line of the developments during the decade past. We should not be in the least surprised to see in the near future battleship designs involving no gun heavier than the ten inch, and in fact in Europe designs embodying these ideas are already in progress.

Passing to other points of more especial interest to the engineer, Admiral Melville calls attention to the possible effects of heavy gun fire on the machinery outfit of a war ship, pointing out that with one hundred or more steam cylinders on board a war ship, with miles of piping, electrical conduits, etc., the shock due to the impact of a heavy shell and transmitted from the point of impact on the armor may have serious effects on much of this network of auxiliary communicaiion, and that it may not be necessary for a shell to explode within the ship to seriously disturb the operation of important auxiliaries.

The author believes that the coming decade will bring the triple screw into more common use, and that some system for burning petroleum satisfactory for war ship purposes will be devised. He also looks for an extension in the use of the steam turbine to torpedo boats and small gunboats, for further development in the water tube boiler into a satisfactory steam generator for marine purposes, and for improvements in the personnel, without which other changes and improvements will be of no avail.

WE publish on another page the more important of the recent amendments and changes in the United States Inspection Service. The importance of these rules and of the changes which are introduced from time to time at the stated meetings of the Board of Supervising Inspectors is perhaps not fully appreciated. This board and its work is the chief barrier which stands between the public at large and the danger which might arise were the design, construction, operation and management of ships left entirely to the discretion of those directly interested. While from the standpoint of higher morals and higher interest it might be thought that a reputation for safety and for attention to the interests of the public would be sufficient to insure all needful precautions, experience shows that this is not so, and that in all cases where the financial interests of employers or of corporations serving the public are not in complete accord with the interest and safety of employés or of the general public, some safeguard for the latter is needed. This has always been true of ships and shipping, and so we have on the one hand the rules of the various registration societies which require a certain standard of excellence in design and construction in order to obtain insurance on favorable terms, and on the other the rules of the Government, which take cognizance especially of all points relating to the safety of the steam machinery, to the adequacy of the equipment for saving life, and to the qualifications of officers, both on deck and in the engine and fire rooms.

The present remarks are not so much for the purpose of discussing the changes in the rules, which seem in the direction of increased efficiency and safety, but rather to call attention to the great work of this office and to its importance both to the shipbuilder and owner, and to the public which they serve.

MISHAPS AND REPAIRS.

Contribution to Prize Contest.

The last contributions entitled to be considered in the prize contest for Mishap and Repair articles were published in the February issue. Many interesting and valuable points were brought out in each article, but the article which is regarded as the best, and which secures the prize of $15, is the one written by James Wallace, published in the issue of October, 1901. The second prize of $10 goes to George H. Waring, for the article which was published in the issue of August, 1901.

All of the articles were paid for at the regular rates and these prizes are given as an additional award because of the practical value of the information given and of the skill displayed in making the repairs.

It is of so much importance that our readers exchange experiences regarding mishaps and repairs of various kinds, that we hope all who can do so, will forward statements of their experiences, accompanying them whenever possible with pencil sketches, which we will have reproduced so that the articles can be published like the others. All such articles will be paid for at the regular rates. There are very few engineers who will not benefit materially by reading of the experiences of others in handling mishaps and repair jobs.

Repairing a Broken Propeller.

During the spring of 1898 the small towboat *Josephine* broke a blade off her wheel while towing lighters at Dutch Harbor, Alaska. On attempting to run the boat with the remaining two blades the vibration was so great as to necessitate laying the boat up until another wheel could be procured, which would take about six weeks. As the stopping of the boat would be an inconvenience, I decided to repair the wheel, if possible.

Having some long timber on hand, I constructed a temporary set of ways and hauled the steamer out. I found the blade broken off 1 1-2 inches from the hub. As soon as the boat was out I took some felt paper and made a template of both sides of one of the blades, allowing for the two plates, of which the new blade was to be made to cross the hub and go up the other blades about three inches. While the helpers were taking off the wheel I cut out two pieces of 3-8 inch plate the shape of the paper template on the hand power shear that we had in camp.

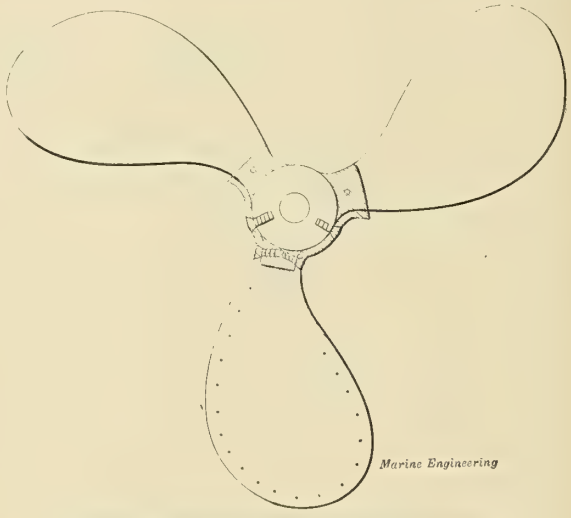
After the wheel was off I made the plates hot in a large forge and bent them to shape over one of the blades. I had chipped 3-8 inch off the sides of the stump of the broken blade to allow for the thickness of the new plates and so make the new blade the same thickness as the old one. The edges of the plates were drawn down and then bolted together, and 5-8 inch holes drilled around the edge 2 1-2 inches apart and countersunk. The blade was then riveted up.

To enable me to place the blade on the hub the same as the other blades, I bored a hole through one of the keel blocks. I then ran a pipe through the hole to correspond to the shaft, upon which we placed the wheel, and by careful measurements clamped the blade to the shaft with the same pitch as the others. We then drilled five holes on each side and put 5-8 inch tap bolts in, and our job was finished.

The engine of the *Josephine* was a single high pressure, and as there was considerable vibration I decided to fill the space between the plates of the new blade with lead and key the wheel on to the shaft, with the heavy blade opposite to the crank, as I had no material with which I could fill the blade so as to bring it the same weight as the others.

Within twenty-four hours after starting, the boat was launched and given a trial. The decrease of vibrations was very noticeable, and when last heard of the wheel was still in use on the boat at St. Michaels, Alaska.

The accompanying sketch will show the manner of fastening the plates to the hub. S. H. McL.



METHOD OF REPLACING A BROKEN BLADE.

Trouble With a Fan Engine.

It was on board one of the new breed of dogs commonly called ocean greyhounds that I had my first experience with the uncontrollable force of steam, when that giant breaks loose from its legitimate line of operation. The greyhound in question was one of the many ferry boats which oscillate pendulumlike between the old and the new world.

The boilers were fitted with Howden's system of hot forced draft, the fans and fan engines being placed directly upon the boilers, the engine, a double cylinder, double acting, being directly connected to the fan wheel, and making about four hundred turns per minute.

Walking through the fireroom on the second watch I heard a noise coming from the direction of the fan flat, and proceeding to climb the ladder leading to this earthly paradise (?) I was greeted by a terrific slamming and banging and the unwelcome roar of escaping steam. Luckily the trap door of the fan flat was closed, thus preventing the broken parts from being precipitated upon my head.

Having informed my superior of the probable state of affairs, we closed the auxiliary stop valve on the

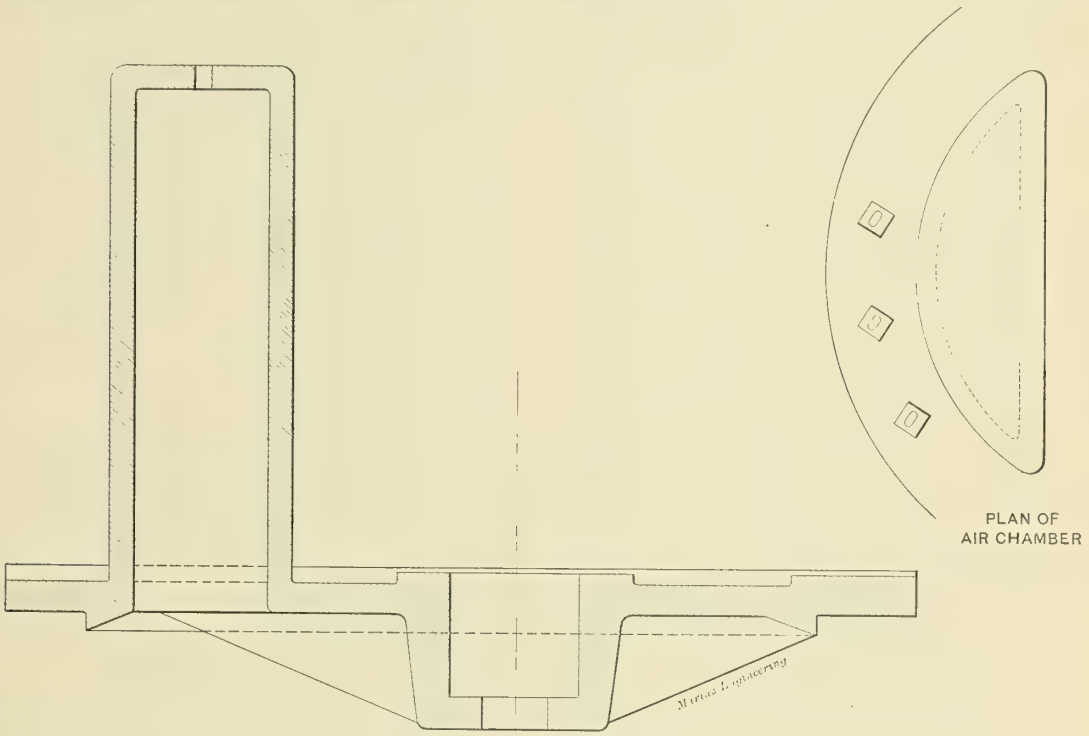
boiler so as to shut off the steam to the fan engine, and then proceeded to open the trap door of the fan flat. It took the combined strength of two men to lift it, and then we saw the effects of the ill-directed efforts of the steam.

First shutting off the exhaust valve on the engine we found the following damage. The shaft had broken off short in the crank web, the crank pin brass bolts on both connecting rods were broken, and the engine still taking steam for one or more revolutions had lifted the covers off both cylinders, carrying away the studs and portions of the cylinder castings.

Both piston rods were bent, as were also the connecting rods, eccentric rods and valve stems.

asbestos cloth being forced in with them. The jacks were screwed hard down and remained in place, thus obviating the necessity of the studs.

The exhaust valve was then opened, the steam stop on boiler opened and the engine was started, not blowing anywhere, and again making 400 turns, and ran this way for four days, until we reached the dock in New York, the only thing necessary being the occasional tightening of the screw jacks. The whole job was done in 8 1-2 hours from the time of stopping the engine until the starting of the same, which shows what can be done in a well appointed ship where the owners do not save at the wrong end, i. e., in the engine room help. X. Z. Y.



AIR PUMP COVER WITH AIR CHAMBER.

Ocean greyhounds are well supplied with engineers, and the job in question did not present any great difficulty except the fact that the temperature in the fan room was about 145 degrees Fah., and all the pieces were hot.

Four engineers and oilers now proceeded to get the broken and bent parts of the engine out, also the shaft out of the fan wheel, while another force of men got out a spare shaft and proceeded to fit the bottom end brasses, eccentric and eccentric sheave.

When all this had been done, the new shaft was put into place, the new connecting rods were put up, new piston and piston rods put in, and everything went well, until we came to put on the cylinder covers. The old ones having been smashed to pieces and the top part of the cylinders and studs having been carried away, a piece of 1-16-inch asbestos cloth was laid over the cylinders, new covers put on, and then two screw jacks braced against the upper deck, and acting on the covers, forced them into the counterbore, the

Broken Air Pump Links.

When the United States Dynamite Gunboat *Vesuvius* was completed, she represented at that time (1888) the highest type in the development of marine engineering in this country. The contract requirements were that she should develop a speed of not less than 20 knots over a measured course of 2 1-2 miles. Before this speed was attained four or five unsuccessful attempts were made. On two of the preliminary trials breakdowns of a more or less serious nature occurred in the middle of the run.

The engines are of the 4-cylinder triple expansion type having cylinders of 21 1-2 inches, 31 inches and two 34 inches in diameter respectively, by 20 inches stroke. The two low pressure cylinders on each engine were forward, and an air pump at the back of each low pressure cylinder was worked by the ordinary plate steel beams connected by links to the low pressure crossheads. One trial trip had been run with the air pumps working successfully, but in the middle of

the second trial, while the main engines were making 260 revolutions per minute, there came a crash which could be heard above the din in the engine room. In the vicinity of the forward low pressure cylinder on the starboard engine, a shower of sparks could be seen.

The engine was stopped as quickly as possible and the cause of the pyrotechnic display was soon apparent. The air pump beams had both broken off about 12 inches from the ends to which the links from the crosshead were attached. At the high rate of speed the engine was running the broken ends had been whirled around at a terrific rate, striking the guides at each revolution. One of the oilers happened to be directly in front of this cylinder when the break occurred but, most providentially, was only slightly injured. The broken end of one of the links knocked an oil can out of his hand, and tore off one of his finger nails. An investigation was made and it was found that the accident was due to a solid rush of water from the condenser to the air pump. The top cover of the pump was also found to be broken.

The broken ends of the beams and the links were disconnected from the crosshead, and the ship returned to the city running at half speed and using, of course, only one air pump on the starboard engine. In order to avoid a repetition of this accident, new top covers were fitted to the air pumps, each with an air chamber cast with the cover as shown in the accompanying sketch.

On all the subsequent trials no further trouble was found with the working of these pumps and, so far as I know, these air chambers are fitted to the pumps yet. In modern practice the fitting of the discharge valve plate as a sort of a "floating top" precludes the possibility of a similar accident from a rush of water.

C. Albert.

An Engine Breakdown.

The steamer *Balance* was one of those crafts, which, instead of navigating the bosom of the ocean, ought to have been safely lodged in Davy Jones' locker long ere this, and the fact that she still defied the laws of navigation and gravitation was due more to the unselfish efforts of the men who incautiously ventured to ship in her, than to the efforts of the owner.

She was a compound job, with cylinders 22 1-2 inches and 60 inches by 36-inch stroke, steam 140 pounds, and turning a right-hand wheel at 60 revolutions per minute.

Rushing through the Cuban waters, bound for New York at the magnificent speed of ten knots, the engineer on watch was disturbed in his pleasant dreams of home and the time when he could leave this floating graveyard, by a terrific crash, and instinctively rushing to the engine throttle, he shut off steam, but in spite of his celerity the engine made another revolution and completed the wreck.

The engine-room was filled with steam and flying pieces of iron and steel. It wasn't necessary to call the chief, since he was at that moment coming down the engine-room ladder. So leaving the chief to give orders, the engineer on watch rushed into the fire-room, closed the stack damper, opened his fire doors and eased the safety valves, and then returned to the engine-room to find out the result of the engine's strange maneuvers.

The crank-pin bolt on the low pressure engine had broken on the up stroke, and one bolt being insufficient to hold the strain, had given way, and the piston rod and connecting rod in their upward course had fractured the cylinder cover. The engine still turning, due to the high pressure engine, the free end of the connecting rod came down, and swinging against the condenser knocked a big hole into it. The engine still turning, the low pressure piston again went upward, and striking the cracked cylinder cover completed its work and made the pieces fly in all directions.

By this time the engineer on watch had succeeded in stopping the engine, and the engine staff now proceeded to make repairs.

The hole in the condenser did not present any material difficulty. Luckily none of the tubes were broken, so the necessity of taking off the condenser covers and plugging up the broken tubes was obviated. Four holes for studs were tapped into the condenser around the hole, and a joint was made with red lead putty and rubber packing, and a board bolted over the whole thing.

The engine, however, was in bad shape, the broken crank pin bolt showed flaws in the forging, the cylinder cover was broken beyond repair, so the chief decided to go into port under the high pressure engine only.

The air pump and the circulating pump being driven off the low pressure cross head, spare crank pin bolts were put into the crank pin brasses, and these connected to the low pressure connecting rod, thus giving motion to the air and circulating pumps.

This piston rod was released from the cross head, the piston raised from the cylinder and lashed to the top of the engine. The low pressure valve chest cover was taken off, the low pressure valve taken off the stem, and the men getting into the valve chest proceeded to fill up the ports by means of wooden wedges, caulking in between the pieces with lamp wick and white lead.

Then the eccentric straps were taken off the low pressure engine, the valve stem blocked up and fastened, the low pressure valve chest cover put on, the steam in the boilers reduced to 80 pounds, and away we went at a 7-knot gait. It was necessary to stop the engines twice on the way to New York to drive back the wooden wedges in the ports, as they showed a tendency to get loose, due to the atmospheric pressure.

The exhaust from the high pressure cylinder passed into the low pressure valve chest and then went directly to the condenser, which maintained a vacuum of 21 inches.

When the vessel arrived at New York, a new cylinder cover was made, and the engine was as good as new. The whole time of stoppage during the time of making repairs was 54 1-2 hours, and due to the fact that the engine-room force was limited to a small number of men, the job was a very creditable one, and the chief was highly commended for his ingenuity and perseverance.

A. B. C.

COMMUNICATIONS.

Robert Fulton.

Editor of Marine Engineering:

Reverting to your article on the "Robert Fulton Memorial" in the January issue, I, in connection with many other of your readers, would like to know the chronological position occupied by the *Clermont* in the history of the steamship. This desire is suggested the more by your statement in the article named that "it is not claimed for Fulton that he invented the steamship," while in the preceding paragraph to that in which this occurs you say, "This trip of the *Clermont* demonstrates that it was thoroughly practicable to use steam power for propelling vessels." These quotations don't seemingly agree, because if the *Clermont* was the first boat to demonstrate the practicability of using steam as a propellant, then Fulton invented the steamship. But as this trial trip happened in 1807 and we have authentic records of a similar trip having been made in 1802 equally as successful as the one referred to, it is difficult to find the basis for the claim made in Fulton's behalf. It is well known that one William Symmington constructed a steam tug boat named the *Charlotte Dundas* and had a successful run with her on the Firth of Clyde canal, Scotland, in 1802, or five years previous to Fulton's effort, and I have always understood that this was the first steamer constructed.

Navis.

In reply to the above communication, we would refer readers who are interested in the early history of the steamboat to the "Growth of the Steam Engine," by Prof. R. H. Thurston, in which will be found in chronological order, the various experiments of early inventors of steam engines and historical information.

To briefly answer the above question, we would state that, like the steam engine, it is impossible to ascribe to any one man the invention of the steamboat. James Watt was the first to make the steam engine a commercial success, yet his invention is the growth of many years of study by himself and early inventors.

In 1707 Papin applied a steam pumping engine for propelling boats on the river Fulda. He later petitioned the Counsellors of Hanover to allow the steamboat which he proposed to build to navigate the waters of the Fulda. Permission, however, was not granted. In 1736 Jonathan Hulls took out in England a patent for the use of the steam engine for ship propulsion and towing. However, it is uncertain that his plans were ever carried out.

The French Academy of Science offered a prize in 1752 for the best essay on the manner of impelling a vessel without wind. This elicited several remarkable papers. In one of them is found a description of a proposed wheel like a wind mill, one to be placed on each side of the vessel and several more behind. In this we may see the embryo of the modern screw. Another proposed to use the Newcomen engine for ship propulsion.

In France the Marquis Jouffrey was one of the earliest to see in Watt's improvements of the steam engine its applicability for the propulsion of vessels. A company was formed and the first vessel was commenced in 1772. However, shortly before completion, the vessel sank and the experiments were discontinued for a time. Another boat was built by Pierre and a trial trip made in 1774 on the Seine with unsatisfactory results. At a public trial of a boat 140 feet long, built by Jouffrey in 1783, some degree of success was attained, but owing to the fact that the National Academy did not indorse the invention, further attempts were given up.

Returning to this country, mention should be made of William Henry, who, on returning from England in 1763, where he met James Watt, placed a small engine in a boat and made a trip on the Conestoga river near Lancaster, Pa. John Fitch was an acquaintance of Henry's and we find that Robert Fulton was also a guest of Mr. Henry in 1785. Fitch produced several small boats propelled by steam, and in one of these is found the first form of paddle wheel. He later built larger vessels, and in July, 1788, made the trip from Burlington to Philadelphia, a distance of twenty miles. As the boilers of this boat gave out, however, she did not prove a success. Fitch continued his experiments and in 1796 he built a small screw steamboat at New York city.

Mention should be made of William Symmington, Patrick Miller, James Taylor, Samuel Morey, Nathan Reed and Elisha Ormsby for their more or less successful attempts at propelling vessels by steam. Lord Dundas became interested in this subject and engaged Symmington in 1801 to build a boat for him which he named the *Charlotte Dundas*. She was propelled by a double acting Watt engine turning a crank with a paddle wheel shaft. After one trip, however, this boat was laid up and we hear nothing more of her. Ten years later Henry Bell constructed the *Comet*, the first passenger vessel built in Europe. She was of 30 tons burden, 40 feet in length, and 10 1-2 feet broad.

From the above facts it is evident that from various causes marine propulsion had not been successful prior to Robert Fulton's time. Many inventors had gone down because of lack of capital to carry out their experiments and construct their apparatus, and in no way would we belittle Fulton's achievements because of the assistance of Robert Livingston. Therefore we can reserve for Fulton the place of honor in the early history of marine engineering. Editor.

Caulking Liners on Propeller Shafts.

Editor of Marine Engineering:

In your December issue I notice a very interesting article on propeller shafts, by Mr. H. F. J. Porter. I fully agree with Mr. Porter that in most cases the fracture of the propeller shaft is due to galvanic action, set up by the steel shaft and the brass sleeves. In the following illustrations I offer to your readers a design which has been used by me successfully in a good many cases.

The object of this design is to separate the two hostile metals entirely, where they are in touch with salt water.

Fig. 1 shows the end of a 12-inch tail shaft nearest to the coupling. *S* is the shaft, which is enlarged where the sleeve is fitted; *B* is the brass sleeve which is allowed to extend on both ends, the bore being dovetailed inwardly as shown, and into the recess thus formed, lead or tin is poured as shown at *A*. After

cooling, this soft metal is well caulked, so it will be perfectly watertight, thus separating the edge of the sleeve from the shaft.

Fig. 2 shows the end of the tail shaft containing the hub of the propeller. Wherever an iron or steel propeller is used, the hub has to be protected from galvanic action as well as the shaft. The forward end of the hub is fitted with a dovetailed recess which projects over the end of the brass sleeve; the latter is reduced at this end to fit the smaller diameter of the shaft, and the shoulder thus formed slightly dovetailed to assist in holding the lead, which is poured into the recess and afterwards caulked.

In the case of the shaft shown in the illustration, the ends of the sleeves were tinned first, causing the metal to stick to it as if it were a soldered joint.

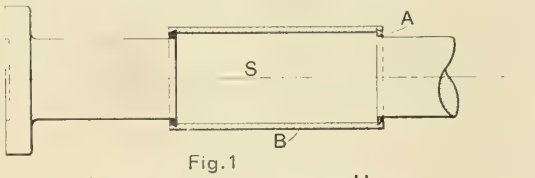


Fig.1

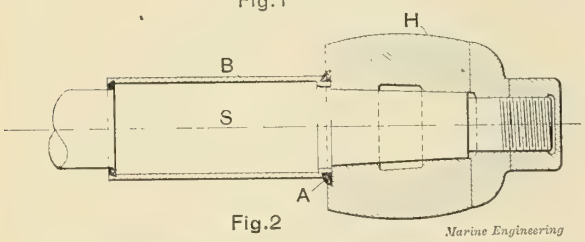


Fig.2

Marine Engineering

The lead should be caulked before the sleeve receives its finishing cut, as the caulking will expand the ends slightly. This shaft was fitted into the steamer *President Boers*, which is plying between Banjermassin and Makassar, in Dutch East India, where the water has a particularly destructive effect on tail shafts. It has been in service for over ten years, but according to the last information I received about it, some three or four months ago, has thus far shown no defects.

When galvanic action attacks a tail shaft, besides the metal that is eaten away, the material which might appear solid is crystallized over a considerable space, thus weakening the shaft considerably.

H. E. Raabe.

LAUNCHES.

Submarine Boat Plunger.—The *Plunger*, the sixth of the submarine torpedo boats built at the Crescent Shipyard, Elizabethport, N. J., was launched on February 1st.

Steamer A. G. Brower.—The steamer *A. G. Brower*, belonging to the United States Transportation Company and built for the iron, ore and grain trade, was launched from the South Chicago yard of the American Shipbuilding Company on December 28. The new boat is 346 feet long, 48 feet beam and 26 feet deep.

Steamer Romona.—The steamer *Romona*, belonging to the Pacific Coast Steamship Company, was launched from Dickie's yard, Alameda, Cal., on December 24. The dimensions are: Length over all, 210 feet, between perpendiculars, 200 feet; beam, 32 feet; draft, 11 feet. She is built for the freight and passenger trade between San Francisco and San Pedro and has handsome accommodations for 150 passengers.

Steamer Minnewaska.—The steamer *Minnewaska*, which is owned by Eastern capitalists represented by C. E. and W. F. Peck and built for ocean trade, was launched from the Cleveland, Ohio, yard of the American Shipbuilding Company on December 21.

Steamer Western States.—The *Western States*, the new Cleveland and Buffalo Transport Company's passenger steamer, was successfully launched at the Wyandotte (Mich.) yard of the American Shipbuilding Company, on January 19th. The *Western States* is a sister ship to the *Eastern States*, which was launched in December, 1901, and her principal dimensions are length on water line, 365 feet, breadth 45 feet, molded depth 20 feet.

Steamship Kroonland. — On February 8th the steamship *Kroonland*, built for the International Navigation Company, was launched from the shipyard of Wm. Cramp and Sons' Ship and Engine Building Company, Philadelphia, Pa. The dimensions of the *Kroonland* are: Length between perpendiculars, 560 feet; length over all, 600 feet; beam molded, 60 feet; molded depth, 42 feet. On a draft of 26 feet the hull displaces 18,000 tons. The gross registered tonnage is 12,000.

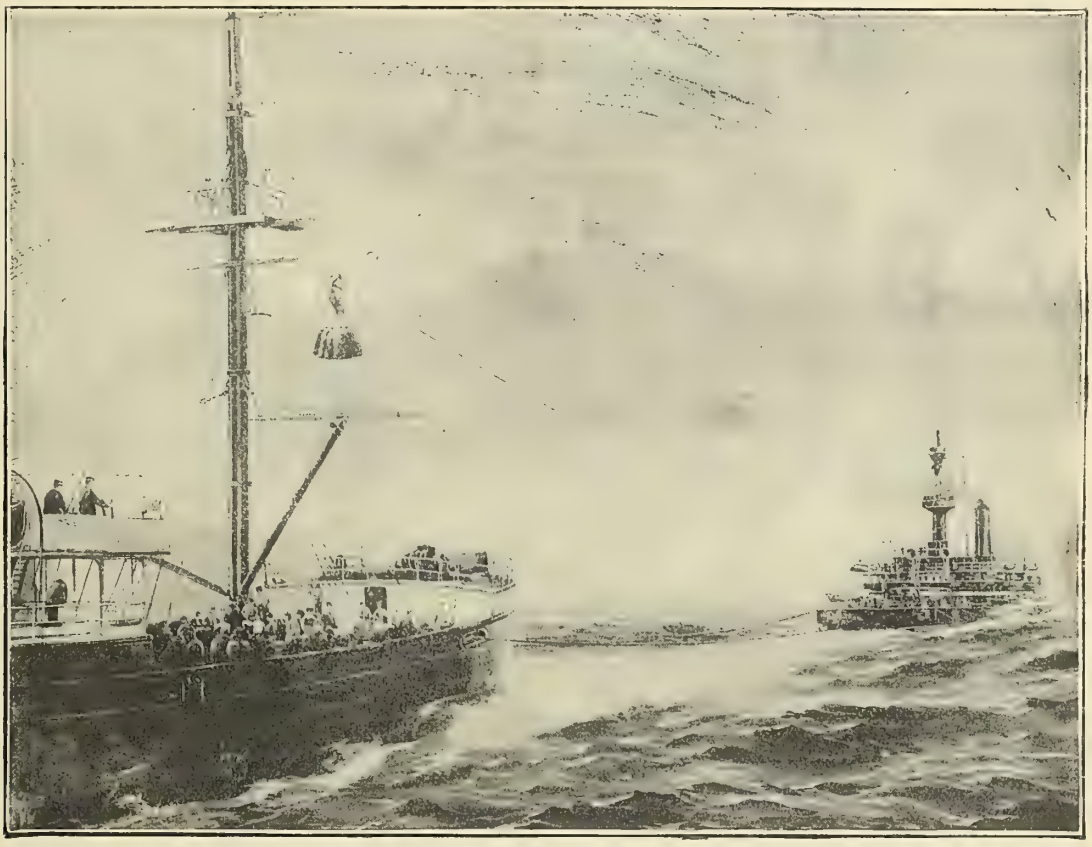
Steamship Nevadan.—The *Nevadan*, the first of the three vessels which the New York Shipbuilding Company is constructing for the American-Hawaiian Steamship Company, was launched at Camden, on January 22d. The *Nevadan* is built for service between New York and San Francisco, and is of the following dimensions: Length, 371 feet; beam, 46 feet; depth of hold, 34 feet; dead weight carrying capacity about 5,300 tons. The boilers are fitted for using oil fuel or coal.

Battleship Missouri. — On December 28th the United States battleship *Missouri*, a sister ship to the *Maine* and *Ohio*, was launched from the yard of the Newport News Shipbuilding and Dry Dock Company. The keel was laid February 7, 1900, and the contract price was $2,885,000. The dimensions of the *Missouri* are: Length on water line, 388 feet; extreme breadth, 72 feet 2 1-2 inches; mean draft, 23 feet 6 inches; corresponding displacement, 12,230 tons. A side belt of armor extends from the bridge, where it is 4 inches, to the after end of the second casement. Amidship this belt is 11 inches maximum. Above this the sides are protected by 6-inch armor. There are two turrets, with 12-inch armor, mounted on barbettes with armor of the same thickness. The armament consists of four 12-inch 40 caliber, sixteen 6-inch 50 caliber rapid fire guns, six 3-inch rapid fire, eight 6-pounders, six 1-pounders, two Colts and two 3-inch field guns. There are two submerged torpedo tubes. The contract speed is 18 knots. She is propelled by two sets of twin screw triple expansion four cylinder engines, with a collective horse power of 16,000. The diameter of the cylinders is high pressure 34.75, intermediate 53, low (two) 63 inch, with a common stroke of 48 inches. Steam will be supplied by twelve Thornycroft boilers, with total grate surface of 1,000 square feet and a heating surface of 51,372 square feet. The complement of officers and men will be 551.

ENGINEERING SPECIALTIES.

Successful Test of Coaling at Sea by British Admiralty.

Important news comes from England of the complete success of the sea trials recently undertaken by the British Admiralty in coaling warships at sea with the marine cableway. The Lidgerwood Miller Marine Cableway will shortly be tested on one of the United States battleships preparatory to its general adoption by the Government, and Russia has already applied it to the latest of its great battleships, now building in this country at the Cramp yards, Philadelphia, Pa. Whatever difficulties may have been encountered heretofore in the perfect working of the device have clearly been overcome in the most satisfactory manner in the latest form of the cableway as perfected by Spencer Miller, the inventor. More than this, its capacity has been increased to a degree which will enable it to give the maximum service desired. All of this is strikingly shown in the test abroad, just completed. It will be remembered that in the trials made by the United States Navy Department it was required that the cableway transfer twenty tons of coal an hour with a distance of 300 feet between ships speeding at the rate of six knots. This was successfully accomplished in a heavy seaway. In the test by the British Admiralty the required amount to be transferred was increased to forty tons per hour, and the distance between ships to 400 feet (making for greater safety), while the speed of the vessels was almost doubled. The official test made off Portsmouth, in the English Channel, on the 4th inst., with the batttleship *Trafalgar* and collier *Muriel* in tow, lasted three hours, and developed a maximum of forty tons of coal transferred per hour. The engraving below shows the two vessels while making the test, and gives a good idea of the working of the marine cableway. The pair of sheaves which was formerly required upon the after deck of the towing vessel, and a canvas chute down which the bags of coal were dropped, has now been done away with. When the load of bags reaches a point in transit immediately over the after deck of the receiving vessel all the cables are pulled down to the deck, the loaded bags deposited, the empty ones hooked on and the cables tautened up again and the traveler returned. In the test by the British Admiralty a large square mast was fitted in the fore part of the collier *Muriel*, and from the top of this the cableway extended to the quarter deck of the *Trafalgar*. An elevator runs on rails secured to this mast and hoists a ton of coal in bags 65 feet to the masthead. A traveling carriage takes the coal bags from the elevator and transfers them at great speed to the warship. A trip every minute is easily accomplished. The traveler is propelled back and forth by a wire rope 1-2-inch in diameter, operated by two direct acting engines having two 10 by 10 inch cylinders, and slipping drums. Instead of using a sea anchor to keep an equal strain on the main cable be-



BRITISH BATTLESHIP TRAFALGAR COALING AT SEA.

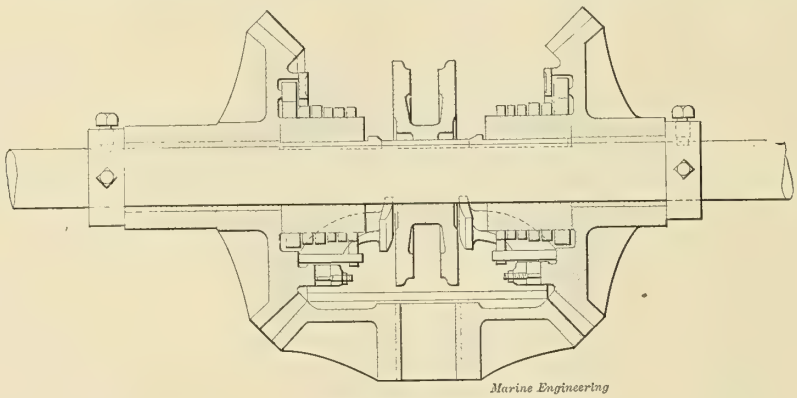
tween the vessels, the same result was ingeniously accomplished by the use of a main cable tension engine, which automatically keeps the cable taut while permitting its length to vary. This engine has two 13 by 13 inch steam cylinders, and is geared to a slipping drum. The engine turns in the same direction all the time, and the slipping drum is given a definite power of about five tons by the slip of its friction heads. Hence the drum maintains a constant pull on the main cable, revolving one way and then the other, as the movement of the ships requires greater or less length of cable. The apparatus is made by the Lidgerwood Manufacturing Company, 96 Liberty street, New York.

The Coil Clutch.

The illustration shows a reversing gear applicable to marine engines as made by the Coil Clutch Manufacturing Co., 45 Broadway, New York, by the adaptation of the B type of Lindsay's patent clutches. The arrangement consists of three bevel gears, two running loose on the propeller shaft and in opposite directions through the third gear as an idler. The motion is communicated from the engine to the gears by a spur wheel keyed on the extended hub of the bevel.

The necessary changes to obtain reversal in either direction are made by means of two clutches. The coil of each is rigidly connected at one end to the bevel gear. The coils are wound around chilled iron drums, keyed to the propeller shaft, and in opposite directions, so that the tendency is to tighten itself when any drag is put on the point or either coil to give an initial grip. When this clutch holds, the gear and propeller shaft become connected, the power is transmitted directly from the engine and motion is communicated in the direction of the corresponding gear. The clutches are manipulated through a lever sliding a double-faced disc along the shaft, which presses either face against a bellcrank lever, which tightens the corresponding coil. A small lever is pivoted on a stud carried from the boss of the gear wheel, and its end projects so that the sliding disc, operated by the clutch lever comes against it. When this is done a projection of the lever comes against an adjustable stop on the end of the coil, and slightly tightens its convolutions. The smallest movement causes the coil to wind itself up and obtain a grip on the chilled boss or sleeves on which it is wound, of such exceeding tightness that it will transmit thousands of horse power. These clutches are made from one horse power to ten thousand horse power for reversing arrangements for propeller shafts, machinery of all kinds and rolling mills. A pair are now being installed at Moscow, Russia, of 12,000 horse power, weighing 127 tons complete. So perfect is the control exercised by the starting gear that the clutches can be started quite gradually, and if desirable, permitted to slip, or they can also be stopped and started as easily, with or without the full working load.

The coils are forged steel bars, gradually tapering toward the point and are wound into helices. The varying section supplies the strength of the part where it is needed, and renders the coil more elastic and delicate in action. Immediately the pressure is released from the coil it liberates itself, while the moment it is pressed it takes up its work without noise or shock. As an evidence of the extreme delicacy of coil clutches, mention may be made of the fact that the same coil will act both as a clutch and a brake.



A NEW COIL CLUTCH.

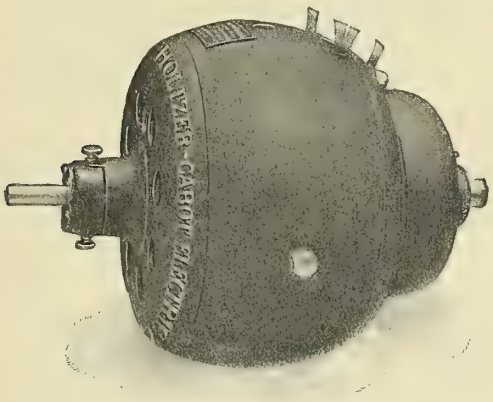
For all general purposes which include hoisting appliances, the B clutch is used singly, or two other types, D and G, built on the same general lines but somewhat modified. The principal as illustrated above governs the working of all these various types.

Electric Motors for Launches.

Navigation is one of the latest fields to be invaded by electricity, and now small launches, and even rowboats, are being driven by electric motors in an entirely satisfactory manner. In the accompanying illustration is shown a half-horse power motor, which is one of a line constructed especially for launch work. As will be observed, the motor is entirely enclosed, being practically moisture proof. If the motor is well protected, or is to be used in fresh water, the weight is materially decreased by the use of aluminum parts where other metals are not necessary for electrical or magnetic purposes; although, if the motor is likely to be exposed to the salt water, brass or iron fittings are recommended, because of the corrosive action of the salt water upon the aluminum. In the latter case the finished parts of the machine are copper plated for the same reason. The shape of the frame is such that two

equal paths are provided for the magnetic flux, one on either side of the armature, a design which allows of great compactness.

As the voltage is low, the current is proportionately large, making the design of the brush holder a feature of great importance. The brush holder used with these motors is of the box type with parallel feed, making it possible to run the motor for a long period of time without any attention to the brushes. A special form of brush is used, consisting of stratifications of woven copper gauze and carbon, the outside layers being of the latter substance with a heavy copper plate. In this way are secured the advantages of the high conductivity of the copper and the wearing qualities of the carbon, the latter also preventing the copper gauze from spreading out and sticking in the holder. A continuous metallic circuit is maintained between the brush and the holder, so that no sliding or imperfect contacts are required to carry current. This



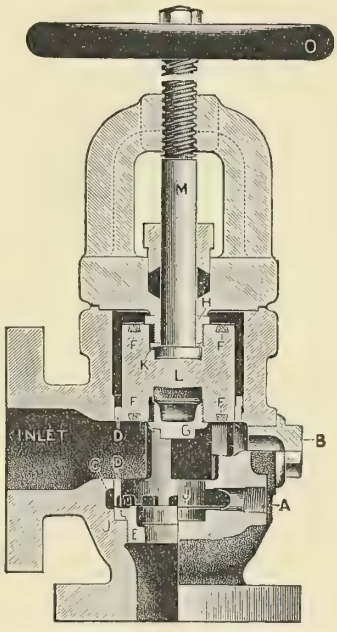
AN ELECTRIC MOTOR FOR LAUNCHES.

makes an extremely efficient and satisfactory brush arrangement for work of this kind, allowing long wear with minimum attention and making heat losses due to the flow of the current insignificant.

The machines are very economical in operation. The speed is low, 1,000 R. P. M., and as they are series wound they use field energy only in proportion to the load, thus modifying two of the most important sources of waste, namely, friction and heat losses in the windings. The voltage is usually low, from 20 to 40 being ample in most cases, so that there is no possible chance of injury to the operator. The motor is usually supported in the stern of the boat by means of heavy braces, which are bolted to the body of the motor. This line of machines is manufactured by the Holtzer-Cabot Electric Company, of Boston, Mass.

Duro Blow-Off Valve.

Blow-off valves have given much trouble because the seat is so located that, as the disk approaches it, the accumulation of scale and sediment cuts into the face, wearing it off and blocking up the valve. The valve shown in the illustration is made by the Lunkenheimer Company, Cincinnati, Ohio, and embodies a simple but ingenious device for obviating this trouble, as it has a self-cleaning seat. There is a small steam inlet *A* which connects with an annular passage *C*. In the iron body of the valve is a brass casing *D*, with circular slot *J* cut into the side just below the level of the seat *E*. The casing is held in place by the ring *E* screwing over same, and both of these parts are easily removed. To close the valve the disk is screwed down in the usual manner, and the edge of the disk passing the lower edge of the casing *D* cuts off most of the flow of water, sediment, etc. The valve in the steam pipe leading to *A* should now be open, thus admitting steam to *C* and *D*, which blows off the surface of the seat *E*.



A NEW BLOW-OFF VALVE FOR BOILERS.

The disk is now closed, cutting off the flow of steam from inlet *A* as well as blow-off from the boiler. The valve in the pipe leading to *A* can be left open at all times, as the disk of the blow-off valve would keep this outlet closed. The disk is reversible, having two faces equally serviceable, and when the faces become worn they can be renewed by refilling with babbitt metal. The other parts may be renewed at slight cost. A plug is provided at *B*, opposite the inlet, so that, if desired, this can be taken off and a rod run through the blow-off pipe to clean it out.

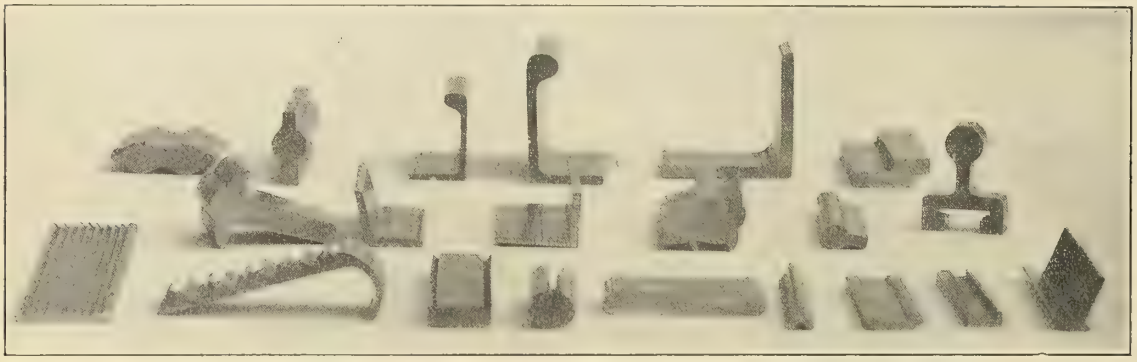
Brass or Bronze Bars Made by the Extrusion Process.

The Coe Brass Manufacturing Company, Ansonia, Conn., is now manufacturing bars of malleable brass, alloys, manganese bronze, Muntz metal, etc., by the extrusion process.

The process consists of forcing the heated metal by hydraulic pressure, frequently as high as 60,000 pounds per square inch, through a die of any desired shape. Owing to the great pressure put upon the semi-plastic metal, its molecules are densely compressed, and its quality must necessarily be greatly improved. Ex-

truded bars or rods consequently possess in a very marked degree those qualities which are essential for sound engineering work, and are free from those defects found in cast, rolled and drawn bars.

The dimensions of the bar being limited only by the area of its cross section, and the capacity of the container holding the charge of metal, extruded bars can be made ranging from light sections weighing a fraction of a pound per foot, to heavy round, square, hexagon or other section rods, more or less complicated, up to 40 pounds per foot. The light sections will run 50 to 60 feet in length, and the heavier angles from 30 to 40 feet.

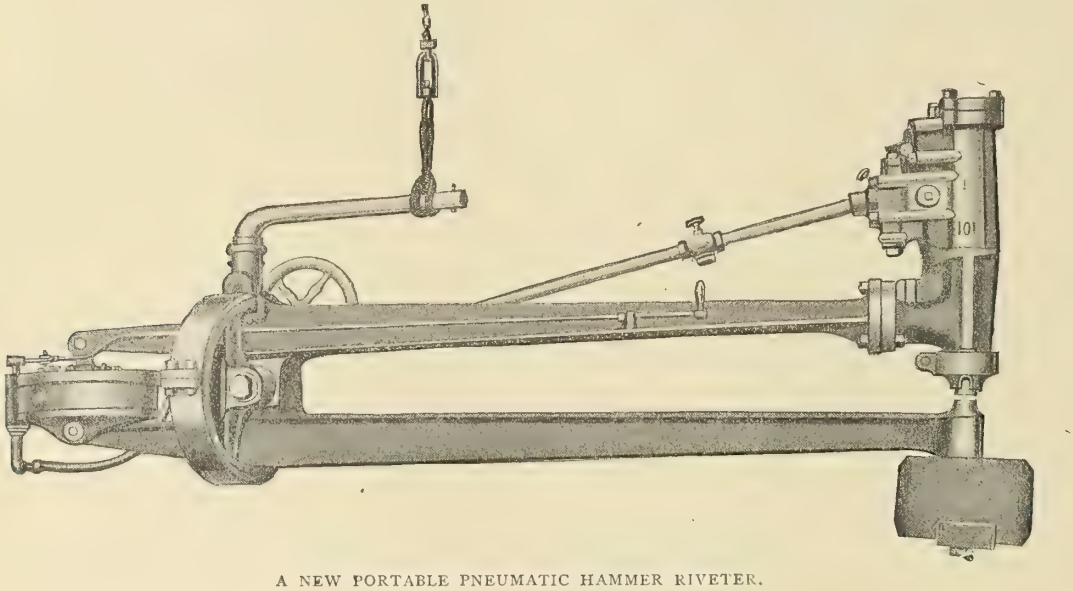


SAMPLES OF BARS OF BRASS AND BRONZE MADE BY THE EXTRUSION PROCESS.

As the dies are changed at every operation when a new charge of metal is put in, easy manipulation and rapid output are insured, so that orders for special sections can be supplied at very short notice after the dies are once made.

Outside of the vast number of commercial uses for these shaped sections, they can be utilized in the following instances: Plain angles, bulbs, T's, I beams, etc., for launches, yachts, torpedo boats and destroyers. This metal takes the places of steel frames, being practically equal in strength to mild steel, and where bronze outside plates are used, the length of time the boat could remain in commission without repairs or drydocking would be materially lengthened.

For forging, these bars can be upset to make spindles, bolts, nuts, screws, stays, etc. This material would enter into construction of general engineering and electrical work and equipment. One of the special qualities which makes this metal valuable for engineering purposes, lies in the fact that its strength is little reduced by high elevations of temperature. The crushing strength of the metal is enormous.



A NEW PORTABLE PNEUMATIC HAMMER RIVETER.

Portable Pneumatic Hammer Riveter.

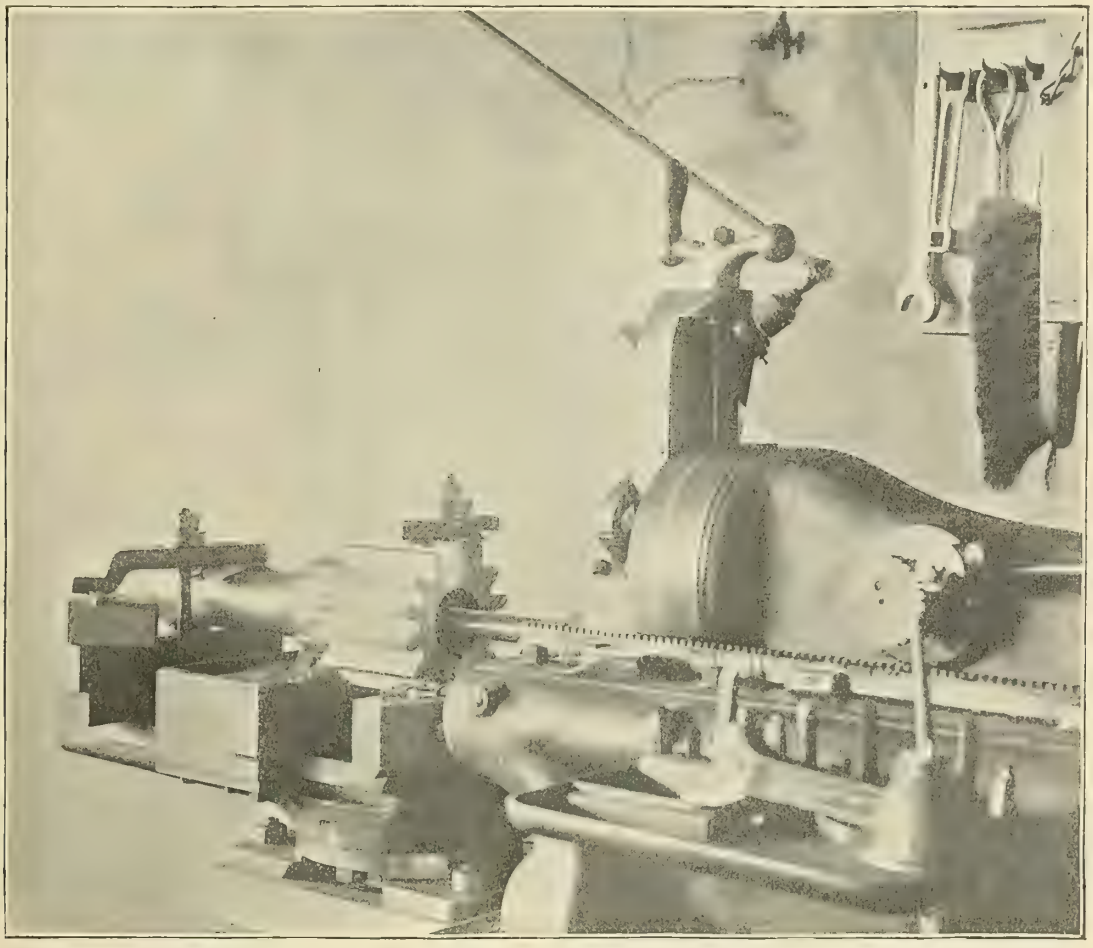
The illustration shown herewith is of a portable pneumatic hammer riveter for use on boiler and tank work, and made by John F. Allen, 370 Girard avenue, New York. It consists of two levers having at one end a pressure cylinder to open and close the levers, and at the other end the riveting machine on one arm and a suitable die with a counterweight attached on the other arm. These arms are of sufficient length so

that the riveter may be used upon circular seams of the boiler. The rivets are supported by a turning ring, which is operated by a worm wheel, thus enabling the machine to be placed at any desired angle to the boiler shell. The riveting machine consists of a cylinder with the hammer head or die attached to the end of the piston rod capable of being easily changed to adapt the machine for different sizes of rivets. The valve is operated directly by the pressure in the cylinder, and with an automatic regulation of the stroke to correspond with the gradual return of the end of the lever as the head is formed. The machine is suitably mounted on a traveling carriage, from which it may be applied to longitudinal seams of boiler shells.

Among the advantages claimed for this machine are that it makes tight work and drives as many rivets as the more expensive machines. A pressure of 3,000 pounds is applied to the plates to close them together before and during the time that the rivet is hammered. The riveter may also be used on small work, such as flues, and it is easily transferred from one part of the shop to the other.

A Handy Shaper.

In the accompanying cut is illustrated a difficult job, which was accomplished in an easy manner on one of the shapers made by Messrs. Gould and Eberhardt, Newark, N. J. It shows the adaptability of their machines to odd jobs as well as regular work. A steel driving pinion for the Holland submarine boat *Fulton* was to be keywayed. The pinion had a long hub and the hole through the hub was 1 1-8 inches in diameter while the hole in the pinion which was to be keywayed was 2 3-4 inches diameter. This would have been difficult to do properly on a keyseater, in which the cutting tool was actuated from below the table, as it would only be possible to use a long and slender bar, which would spring and make an unsatisfactory job.

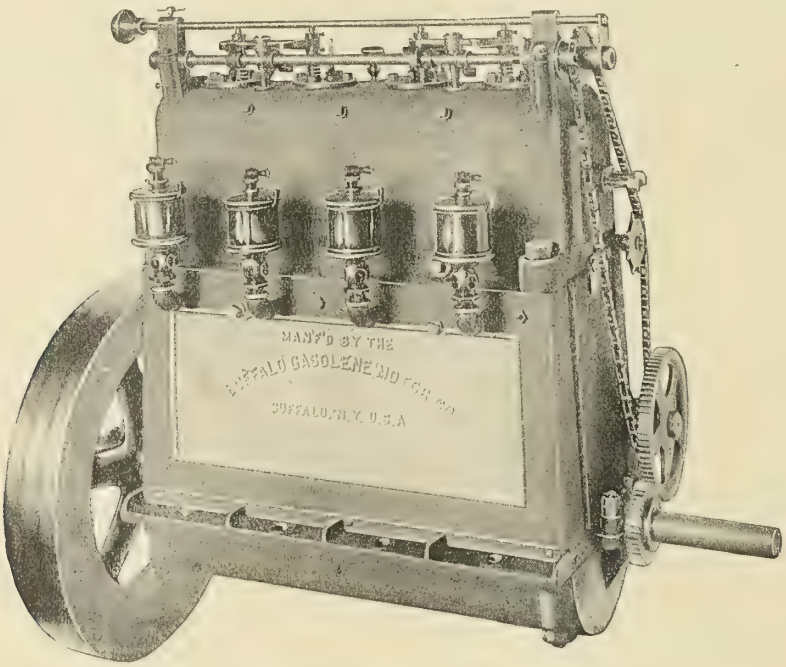


ILLUSTRATING THE USE OF A SHAPER IN PERFORMING A DIFFICULT OPERATION.

The pinion was clamped in the vise as shown, and to still further hold it, two bolts were employed, one on either side, at the front and back ends. The vise is provided with two T slots, one on each side of the screw, into which the heads of standard bolts were inserted, and the work tightened down by nuts and washers. A hole had been previously bored in the pinion to allow the chips to drop out at the finish of the cutting stroke. The cutter bar was held in a taper bush fitted to the hole in the flopper box used for tool post. The flopper box was held rigidly by gib screws, and this, together with the support given by the outer end of the cutter bar in the small hole in the hub insured a smooth, steady cut, and the job was finished in a comparatively short time.

Four Cylinder Gasolene Marine Motor.

A four-cylinder gasolene marine motor has been placed on the market by the Buffalo Gasolene Motor Company, Buffalo, N. Y., which embodies many good features and designs. This company manufactures both gas and gasolene motors of any size up to 80 horse power, for various classes of work. The standard type of motor, however, for either horizontal or vertical installation, is made in four sizes, namely: 4, 7 and 12 horse power. The accompanying illustration shows one of the 7 horse power vertical type of motors. The smallest size has two cylinders, and the two other sizes four cylinders. The 4 and 7 horse power may vary from 200 to 1,500 turns, and the largest size from 200 to 1,000 turns. A special feature is the ignition system by which this wide range of speed is possible. The ignition points are made of a special composition, and are riveted on, thus preventing them from burning or dropping off. Both the cylinders and heads, including the valves, are water jacketed, and all connections are made with double lock nuts and split keys. In the four-cylinder type, vibration is exceedingly small. The total weights of these three sizes are 255 pounds for the smallest, 315 for the 7 horse power and 475 pounds for the largest size. About one-fourth of the weight of the larger sizes is in the fly wheel. The directors of the Pan-American Exposition awarded this company the highest medal in this class. Further information may be had from the company, or from Charles E. Ingot, Humboldt street and Ingot avenue, Brooklyn, N. Y.



A FOUR CYLINDER MARINE GASOLENE ENGINE.

Repairs to Lake Steamers.—It is estimated that between seven and eight million dollars has been spent on repairing lake steamers during the present winter.

THE PROFESSOR ON SHIPBOARD.

Story of an Attempt to Combine Theory With Practice.

BY C. A. MC ALLISTER, FIRST ASSISTANT ENGINEER, R.C.S.

CHAPTER VII.

When the Professor awoke from his refreshing slumber he found that the afternoon had nearly gone. The Captain announced to the passengers that they would, in all probability, sight land early the next morning, and that they would anchor in the harbor of St. Thomas, Danish West Indies, by eight o'clock. This was very cheering news to the Professor, and the prospects of lying in a smooth harbor where the ship would cease to roll for a time, not to mention the chance of stretching his legs on shore, proved very exhilarating. For the first time since he was overcome by the heat he sat down to the table, where he was congratulated upon his rapid recovery by a number of the passengers. Indeed, from the vivacity of his conversation, one could have well imagined that he had partaken of some very potent tonic to bring about such a change in his demeanor. With considerable glee he discussed the probability of the news that they would hear of the busy world since their departure from New York. He also made arrangements with several congenial persons to make a short sight-seeing trip on shore the next day. After dinner he resumed his seat on deck. He was soon joined by the Chief Engineer, who, after congratulating him on his improved appearance, told him that a number of the tubes had been found to be leaking so badly in the port forward boiler that he had been compelled to cut it out, and let the fires die down. He announced his intention of having the leaky tubes removed and new ones put in, after they got in port.

"As this will take us at least 48 hours, I will improve the opportunity and have the boiler given a thorough cleaning."

This statement led the Professor to inquire as to when the boiler was last cleaned. To this the Chief replied that the boiler in question had not been given a thorough cleaning in over a month. The visitor expressed considerable surprise at this remark, and said that he thought a boiler constantly under steam should be cleaned at least once in two weeks.

"That's all very well in theory," responded the Chief, "but you would find out, if you were running the steam machinery on a passenger ship, that you would not have the time to clean boilers so often. The owners want to keep the ship moving as rapidly as possible, and with the short crews they allow us in the engine department, we have to hustle to keep up even ordinary repairs and adjustments. If it were not for the fact that I have got to put in a lot of new tubes I wouldn't attempt to take the time for cleaning while we stop at St. Thomas."

The Professor argued that it would pay the vessel owners to take the time to have the boilers cleaned, claiming that the delay would be more than compensated for by the additional speed the vessel could make with clean boilers. He further added that if more care was exercised in the use of cylinder oil there would not be so much necessity for cleaning the interior of the boilers.

"It is not alone the cylinder oil that gives us trouble with the interior of our boilers," said the Chief; "we also have to contend with scale."

"I shouldn't think there would be much scale in your boilers, as you use an evaporator for the make-up feed supply." "Of course we do," said the Chief, "but you evidently forget that it is almost impossible to get a surface condenser perfectly tight, and as a result there is bound to be more or less leakage from the salt water ends to the steam side. In this way the salt water gets into the feed system and the result is that, in spite of the greatest care, a mixture of oil and scale is formed on the heating surfaces. You theoretical people imagine that because a condenser may be tight when it is first built, it will remain so for the rest of its existence."

"Oh, no, we don't," replied his brother, "but I did not imagine that the leakage in the condenser would have any appreciable effect on the formation of scale in the boilers." "Why," continued the Chief, "you have no idea of the different ways salt water does get into boilers sometimes. I have known cases where a vessel has been lying alongside of the wharf for a week or so, and the main condenser not being in use; yet in a few days I have discovered that the water in the boilers had become salted. This condition was no doubt largely due to carelessness on the part of the water tenders. For instance, when they use the auxiliary feed pump for pumping up the boilers they never took time to pump a few strokes overboard to get rid of any salt water that may have been in the pump cylinders and pipe connections. Another cause is that they neglect to close the sea suction valve tight on the manifold, and the result is that a small amount of salt water will be drawn in from that source; then, too, the sea suction valve may leak, in which case salt water will leak in, even if the valve is closed tightly. Why, I even caught one greenhorn who had been told to pump up the boiler from the fresh water tanks, with the bilge suction valve open, and there he was pumping bilge water in as feed water. You can bet that I put him on the dock in short order. It is all very well to wonder how salt water gets into boilers, but when you have had some of the experiences I have met with, your only surprise will be that more of it does not get in. If every man in the force worked like a machine, it would be all right, but on board ship you must watch everything closely or else you will get into all kinds of difficulties."

The Professor saw the force of his brother's arguments and had no more to say on that subject.

"I suppose you will renew the zincs in the boiler when you clean it out," remarked the Professor after a pause.

"Oh, yes," said the Chief, "we will put some new blocks in if they are necessary; but I don't take much stock in the use of zincs anyhow; they are said to be of great benefit, but I don't see that it makes much difference whether they are in there or not." "That is probably due to the fact that your zincs are not properly fitted," retorted the brother. "I am surprised to find how few people really understand the object of fitting zincs in a boiler, and the proper method of fitting them."

"Well, I must admit that I don't understand the exact theory of it myself," replied the Chief, "but perhaps you can enlighten me."

This gave the Professor an opportunity to expatiate on his ideas of the question, so he commenced thus:—

"The principal difficulty encountered in the care and preservation of the interior of marine boilers is to guard against corrosion and pitting. General corrosion uniformly distributed over the inner surfaces is not so bad, as with ordinary care, its effect, even after the boiler has been in use for several years, is hardly noticeable. 'Pitting' is quite a different problem to contend with, as it is generally manifested locally and at times its action is very quick. There are instances on record where new boilers have had to be re-tubed after being in service for only six months. Various theories have been advanced as to its cause, but it is now generally conceded that it is principally due to electro-chemical action. This action is on the same principle that electricity is generated in an ordinary electric battery, such as is used for ringing bells, etc. In such a battery, you know, a current is generated by the immersion of two metals or other substances of a different electrical potential, usually copper and zinc. The result of the continued submersion of these two metals in an acid liquid is the gradual disintegration of the zinc. A marine boiler containing water which has been allowed to become acid is in a manner an electric battery. With internal feed pipes, blow pipes, fittings, etc., of brass or copper, there is a tendency to start a flow of electricity between them and the steel of the boiler. The result is that certain portions of the steel or iron

becomes disintegrated and leaves small depressions or pits in the surfaces under the water. The copper is not alone responsible for galvanic action, as a current may be generated between different grades of iron or steel and even between the metal itself and the scale formed on its surface. When lap welded steel tubes first came into use, it was found that they corroded and pitted much more readily than charcoal iron tubes. Many persons attributed this condition to the fact that steel was more readily attacked by this pitting action than iron tubes. The fact of the matter was that to get steel to weld properly the tube manufacturers were compelled to use material cut from the tops of the ingots as they were cast; this, as you know, is very spongy metal, and the result was that the tubes proved very unreliable and eventually went out of use entirely. Since the advent of seamless drawn steel tubes it is found that they resist corrosion and pitting even better than charcoal iron tubes. Now to prevent this internal pitting the best plan is to keep the water from becoming acid. A galvanic battery will not work in absolutely pure water, and for that reason, as you may have noted, blue vitriol or sulphuric acid is put in the water of the cell. So it is with boilers, if the water is kept as nearly pure as possible, there is very little galvanic action. It is a very simple matter to test the water in a boiler; all you need to do is to draw out a glassful from one of the gauge cocks and drop in a small piece of litmus paper. If the water is acid the paper will turn red, but if it is alkaline the paper will retain its original color, blue. On naval vessels the engineers are required to make frequent tests of the water in the boilers for acidity. When it is ascertained that the water is in an acid condition steps should be taken to neutralize it by adding an alkaline solution, such as soda-ash. Zinc in the boilers also tends to neutralize the acidity, owing to the formation of zinc chloride during the decomposition of the metal. The principle use for the zinc is, however, to prevent the electro-chemical action, as it furnishes a material which is more electro positive to the copper, etc., than the iron or steel. Consequently the zinc is first attacked by the galvanic action.

"Now as to the method of putting the zinc in the boilers. From what I understand, the prevailing practice on board ship is to simply attach a clip to a slab of zinc and simply clamp it to the tubes or braces, without paying much attention to how it is secured. This is rather bad practice, for the zinc crumbles up and the detached particles get in the bottom of the boiler and are liable to stop up the blow valves. A much better practice is to place several slabs in a basket made of wrought iron or steel plates. The sides and ends of these baskets should be perforated so as to allow a free circulation of the water through them. The bottoms of the baskets should be left solid so as to catch the small particles of zinc as they become detached by the galvanic action. The most important thing to be considered is to have metallic contact between the zinc blocks and some parts of the boilers. That portion of the brace or tube to which the clamp for supporting the basket is to be secured should be filed bright, and the clamp should then be secured tight. It is also a good idea to cover the joint between the clamp and brace with putty or cement to keep the water from rusting the joint. The handle to the basket should be riveted to the sides, and if possible there should be an iron bolt passing through the sides of the basket and through each block of the zinc. Just here it may be well to call your attention to the fact that the blocks should be separated from each other. If they are put in so that they touch each other, it will be found that the blocks will swell and naturally burst the basket.

"Rolled zinc is said to be better for this purpose than cast zinc. However they are placed, the greatest care must be exercised to secure and maintain the metallic connection, as otherwise the zinc will be of very little use. Care should also be taken to distribute the zincs in such a manner that all of the inner parts of the boiler are uniformly protected."

The Chief had been listening attentively to what his brother had to say in regard to zincs, and at the conclusion of his remarks said, "I had no idea that it was so important to fit these zinc blocks so carefully, and after this I will give that matter more attention."

The Professor looked at his watch, and finding that it was getting rather late in the evening, told his brother that as he still felt somewhat weak and fatigued, he would retire, so as to get up early in the morning and be ready to go ashore.

At six o'clock the following morning the Professor was called, and as he got up and looked out of his stateroom window he was much elated to see that land was plainly visible straight ahead. After dressing he went out on deck and found that most of the passengers had also risen early and were gathered in groups on the upper deck gazing wistfully at the green hills in the distance. Good humor prevailed and the Professor secretly wished that the land in sight was the coast of New Jersey and that they were about to enter New York harbor. All hands ate an early breakfast and began making preparations to go on shore. Shortly after eight o'clock the anchor was dropped and the ship was safely moored in the harbor.

The Professor looked into the engine room door, and stood there in meditation for a few moments. The men on watch had already begun to wipe down the engine and clean up around the engine room. The college man could not help but compare the engine with a thoroughbred horse which had just finished a hard run and was being groomed by the attendants. But how different the work performed by the animal and by this creation of man! Ever since the vessel had left New York over a week before, the faithful engine had kept steadily at work hour after hour, day after day, never tiring, but keeping up a continuous turning of the propeller. He also made mental comparisons between the performance of a marine engine and that of locomotives and stationary engines. After a run of a few hours a locomotive is taken to the shelter of a round house and groomed for another run on the following day. Stationary engines run during working hours and are usually shut

down half the time; but the sturdy marine engine must keep going day after day for periods often as long as fifteen or twenty days at a stretch, without ever stopping. The safety of the ship and the lives of the passengers and crew depend upon its faithful performance of duty. Surely, throught the Professor, man has created no more wonderful mechanism than the marine engine. Too much care and attention cannot be exercised in their construction, nor too much credit given to the men who successfully operate them at sea. While thus absorbed in thought, Barney approached him unobserved and somewhat startled the Professor by saying:—

"Well, sor, you look as plased as if you had just got a letter from home with money in it."

"I feel somewhat that way, Barney," replied the college man.

Just then one of the sailors came up and told him that the boat was ready to take the passengers ashore. The Professor got out his sun umbrella and climbed into the boat with a party of the passengers. Soon they were at the landing and as they stepped out, the usually sedate looking college man had the appearance of a colt let loose in a pasture. If he had known how, it is within the bounds of possibility that he might have attempted a cake walk.

The party of passengers wandered about the town, visited the fort, called on the American consul, purchased curios, took a drive out in the suburbs and in the evening took dinner at one of the leading hotels. After dinner they sat out in the park listening to the music of a very good military band. The tropical air was scented by the numerous flowers in the park, and as the evening was cool, the party enjoyed their brief respite on shore to the utmost. When it came time to return on board ship, the Professor and one or two others made up their minds to stop at the hotel over night. The Professor had never before realized what a luxury it is to stretch out in a large roomy bed, and he concluded that a sailor's life is not a happy one, when compared with that of any ordinary citizen on shore.

QUERIES AND ANSWERS.

Q.—Will you please advise me regarding the following:—

On the bridge of our steam yacht, within two (2) feet of our compass, is an electric searchlight. It appears to effect the compass to the extent of a point or more.

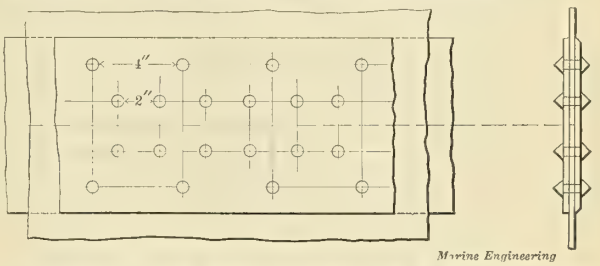
Kindly let me know whether it is probable that it is effected as above, and if so, how far apart it will be necessary to have the compass and the searchlight to overcome same. Will five (5) feet be sufficient? The compass is Sir William Thompson's make, and is very sensitive. S. S. E.

A.—The extent to which an electric searchlight would affect your compass will depend largely on the details of the construction of the light, and especially on the number and strength of regulating magnets which may be employed. It is very sure, however, that with the usual type of light at a distance of only two feet, any good compass would be affected, and especially one of the type mentioned. The average extent to which a light affects the card can be determind by making careful observations on various courses with the light on and off, and this is by all means the best way of finding a suitable distance to which the light should be removed. With many forms of light five feet would still be too near, but with a small yacht light it may be found to be a sufficient distance. Probably, however, eight or ten feet would be better. The only satisfactory way will be to try by experiment until a distance is found at which there is no sensible disturbance due to the operation of the light.

Q.—Please let me know through your valuable paper, the percentage of strength of the following boiler seam:—

Sheets 1-2 inch thick, 60,000 pounds, T. S., boiler 10 feet in diameter, butt joint, strap in and outside, same thickness as shell, 5-8 inch rivets pitched, 2-inch and 4-inch.

What I want to know is how much strength these straps add to the sheet and how this is found.



Marine Engineering

A.—We must first compare the strength in the plate and in the rivets. To do this we find the two efficiencies for the rivets and for the plate. Assuming that the rows of rivets are properly spaced and that rupture can be held to the outer row of rivets, then the joint efficiency so far as the plate is concerned, is (4—11-16) ÷ 4 = .83 nearly.

To find the efficiency of the rivets we must adopt some figure for the relative strength of a rivet in double shear and in single shear, and some figure for the relative strength of a rivet in shear and for the plate in tension. You have taken the rivet in double shear as having twice the strength in single shear. This is more than is usually allowed. The British Board of Trade authorizes the ratio 1 3-4. You have, however, taken the shearing strength as 2-3 the strength in tension. This is perhaps rather low. Taking .7 for this ratio we should then have for the rivet efficiency the following expression: (3 × 7-4 × .3712 × .7) ÷ (4 × 1-2), which equals .685. On this basis, therefore, the joint is weaker in the rivets than in the plate. If we should use the proportion authorized by the British Board of Trade, which is .821, we should find in the same way an efficiency of .805, showing still that the rivets are weaker than the plate.

Regarding the pressure allowed, figuring by the United States rule and adding 20 per cent for double riveting, as the rule allows, we find 100 pounds. Using the British Board of Trade rule with a joint efficiency of .805 we should find 88 pounds as the allowed pressure. By Lloyd's rule the efficiency of the joint becomes .83, and using their rule for pressure in the form usually employed, the allowed pressure on a 10-foot boiler with double butt straps, is found to be 83 pounds.

Regarding the effect of the double butt straps, the efficiency and strength for a single butt strap or for a plain lap joint should be figured as follows:—

There are two rivets in single shear and the joint efficiency in the rivets, allowing a shearing strength .821 the tensile strength, is given by the expression:—

$$(3 \times .3712 \div .821) + (4 \times 1\text{-}2) = .46$$

The plate efficiency must now be taken along the inner row of rivets, since there would be nothing to prevent rupture along this row. This would give for the plate efficiency:—

$$(2 - 11\text{-}16) \div 2 = .66$$

The given distribution of rivets is not of course the best for a plain lap joint, but with a more suitable distribution a better efficiency could be realized. With the distribution as given, however, these figures show that the addition of the second strap results in raising the figures for efficiency from these very low values to the higher values given above.

Q.—How is the tonnage of steam vessels rated? That is, is the number of cubic feet cargo carrying capacity reckoned on in figuring the tonnage, or is it the entire displacement of vessel, displacing a corresponding volume of water?

Supposing a vessel rated 3,000 tons gross and used as a freight boat was altered on her deck and between decks and changed into a passenger steamer, thus losing the considerable amount of space which otherwise would be utilized for cargo. Would this decrease the gross tonnage of vessel as rated by United States steamboat inspectors, and if so, to what extent would this loss of cubic feet cargo capacity affect the tonnage of the vessel? L. S. R.

A.—The necessary space required prevents a full statement of the rules for measuring tonnage. They will be found in the Navigation Laws of the United States, Revised Statutes, Title XLVIII., Chapter I, sections 4,150, 4,151, 4,152, 4,153, 4,154 and also Chapter 398.

We may briefly explain, however, that the tonnage of a vessel is intended to relate to the carrying capacity of the ship, and is based upon the internal volume, and not upon the displacement. The gross tonnage represents in a general way the total internal volume of the ship below the so-called tonnage deck. From this total volume the volumes of various spaces are subtracted, thus giving the net tonnage. These spaces deducted include in a general way the spaces or compartments occupied by or appropriated to the use of the crew of the vessel, but this deduction must not exceed five per cent of the gross tonnage.

Again, in every vessel propelled by steam or other power requiring an engine room, the volume of the space or spaces actually occupied by or required for the proper working of the boilers and machinery, and in the case of vessels propelled by screw plus 75 per cent of the volume of such space, is also subtracted. Again, in no case shall this subtraction exceed 50 per cent of the gross tonnage.

If the changes to which you refer in the vessel rated at 3,000 tons gross, were such as to leave the crew space and machinery space the same, then there seems to be no reason for assuming a change in net tonnage. It would be well, however, in regard to the details of government practice in these matters to consult with your nearest local inspector.

Q.—Will you explain how the formula $D^2 \times .7854$ for the area of a circle is found? All the hand books have it, but none of them explain why.

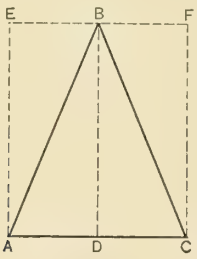


FIG 1.

A.—You know perhaps that the area of a triangle such as *ABC* is found by multiplying the base *AC* by the altitude *BD* and taking one-half the product. If this is not clear you can readily see that the triangle *ABC* is made up of two triangles *ABD* and *BCD*. Now, taking the first it is clear that the triangle *ABD* is equal to the triangle *AEB*, and therefore that each of them is half of the rectangle *AEBD*. In the same way the triangle *DBC* is the half of the rectangle *DBFC*. Hence the whole triangle *ABC* is also the half of the rectangle *AEFC*. But the area of the rectangle *AEFC* equals the product of the base by the altitude, or *AC* x *BD*. Hence the area of the triangle, or half of this will equal half the product of the base by the altitude. Now, to turn to the circle, suppose that it is divided up into a very large number of triangles, as indicated in the figure. Then the area of any one of the little triangles, as *OAB*, will be one-half the product of the base *AB* by the altitude *OP*. Now, if we should make the number of triangles larger and larger and the length of the base, as *AB*, smaller and smaller, then the altitude *OP* would become more and more nearly the same as the radius of the circle or side of the triangle *OA*. Finally, when the triangles get down in our imagination almost too narrow to think of, we can imagine that the difference between *OA* and the altitude *OP* will become too small to be of any importance. Also at the same time the base of the triangle *AB* will become so nearly a part of the arc of the circle that the difference will be of no importance, and in the same way the area of the triangle will become so near to the area of the corresponding part of the circle that the difference will be of no importance.

The sum of the areas of all the little triangles would then be so near to the area of the circle that the error would be of no importance. Now, since each one of them is measured by one-half the product of the base by the altitude, it follows that the sum of them all will be measured by one-half the product of the sum of the bases by the altitude. But the sum of the bases as we have seen, is the circumference, or so near to it that the difference is of no importance, while the altitude is the radius *OA*, or so near to it that the difference is of no importance. Hence, the area of the circle is measured by one-half the product of the circumference by the radius, or at least so far as we have been able to see, the difference between this and the true value will be of no importance.

Mathematicians are able to tell us that when we imagine the little triangles carried on down to absolutely the farthest limit, when they become indefinitely large in number and indefinitely small in size, then the altitude becomes really the radius, and the sum of the bases becomes really the circumference, while also the sum of the areas becomes really the area of the circle without any difference from the true value in either case. Hence we may consider that for finding the area of a circle we have the rule, "Take half the product of the circumference by the radius." Now, if we put this in algebraic form we shall have:—

$A = 1/2\,CR$

where C stands for circumference and R for radius. Now, if we put D for diameter we shall have $D=2\,R$, or $R=1\text{-}2\,D$ Putting this into the equation above we shall have $A = 1\text{-}2\,C \times 1\text{-}2\,D$ or $1\text{-}4\,CD$. Now, again, mathematicians are able to tell us just what the relation is between C and D, the circumference and diameter of a circle. This number is often denoted by the Greek letter π called *pi*, and the value usually employed is 3.1416. Hence we shall have $C = 3.1416\,D$. Putting this for C in the value of the area above and we have $A = 1\text{-}4 \times 3.1416 \times D \times D$.

Dividing 3.1416 by 4 we find .7854, and multiplying $D \times D$ we have D^2. Hence we find at the end of our operation:—

$A = .7854\,D^2$ the formula you asked about at the beginning.

Q. We have a vertical triple expansion engine, with cylinders 15 1-2 inches, 26 inches and 42 inches by 22-inch stroke.

With valve gear linked up so as to cut off, as in the following table, steam at 155 pounds, intermediate receiver 45 pounds, low pressure 0 and vacuum 23 inches, we get these results:—

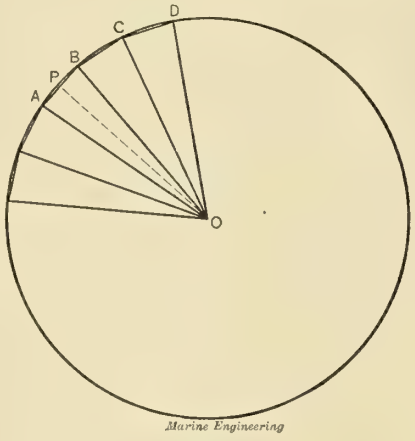


FIG 2.

	Cut off.	Lead.	Lap.	I. H. P.
H. P.	10 1-2 inches	1-16 inch	1 9-16 inches	187
I. P.	11 3-4 inches	1-16 inch	2 7-16 inches	225
L. P.	13 inches	3-16 inch	2 19-32 inches	123

With the engine in full gear the points of cut off are, high pressure, 13 5-8 inches; intermediate pressure, 13 5-8 inches; low pressure, 14 7-16 inches.

We are putting in new boilers to carry 180 pounds of steam, and wish to change valve gear so as to equalize the high pressure in each engine when running full gear. Can we, by changing the valve gear, equalize the power, and if so, how can it be done? The valve gear is of the Joy type. H. H. A.

A. The equalization of power in the cylinders of a triple expansion engine is brought about by changing the cut off in the intermediate and low pressure cylinders. Making the cut off later in either of these cylinders will decrease the power in that particular cylinder, and making it earlier will increase the power. If the distribution of power in full gear is therefore similar to that linked up, and as given in your letter, it would indicate that the intermediate cut off should be made later, and the low pressure cut off earlier. How much this should be changed can only be found by actual trial. It is to provide for the possibility of such an adjustment of cut off that valve gears often contain an adjustable piece, so arranged that each cut off may be varied independently of the others, and an adjustment for equalizing the power thus effected. Such an adjustment is often met with in the Stephenson link gear, in the

form of a block moving in a slot formed in the rock shaft arm, and controlled by a screw. In the Joy gear such an arrangement is less commonly found, but it might easily be fitted. It requires simply some means of varying the connection between the rock shaft arms and the reversing radius, so that each radius may be adjusted independently of the others. Then, with the high pressure cylinder in full gear, the other cut offs should be adjusted until by the indicator a satisfactory distribution of power is brought about.

Q.—What is the average cost per indicated horse power of the best type of modern steamships, using high pressure and triple expansion engines? Also, the coal consumption per hour per indicated horse power, and would the consumption vary per indicated horse power in the case of a 2,000-ton vessel with two triple expansion engines and one triple expansion engine? Also, would the proportion vary in a 10,000-ton vessel? That is, would the economy of a 10,000-ton vessel using one triple expansion engine and consuming steam with this one unit be more economical than by using two units; and the same in regard to the 2,000-ton vessel?

Can you inform me if there is any paper or book published which enters into the statistics of the running costs of single or twin screw modern steamers?

L. S. R.

A.—We suppose that you mean by the first part of your question the cost of propelling machinery per indicated horse power. There is no relation whatever between the cost of the ship and the indicated horse power. The cost of propelling machinery per indicated horse power varies through wide limits of course, depending on the grade of work and other circumstances. From $20 to $40 per indicated horse power will, however, cover the usual range of prices.

The coal consumption per hour per indicated horse power in modern practice varies from 1.5 pounds to perhaps 1.8 pounds. Where especial attention to economy has been paid this figure may be reduced below 1.5, and there are records of performances as low as 1 pound per indicated horse power per hour. With the large units named there is no necessary relation between the economy of the engine and the size, and there is no reason why there should be any sensible difference in the economy of two triple expansion engines or one of the same total power. In a general way we might expect a slightly better economy for the larger engine, and therefore for the 10,000-ton vessel, but this is so slight as to be easily lost or obscured by slight differences in the conditions of operation.

We are not aware of any paper or book giving statistics of the running costs of single or twin screw modern steamers.

Q. What is the proper way of connecting a motor starter with the motor? Should it be connected so as to have the resistance in the armature circuit or in the main circuit? Please let me know which is the proper way, and why.

B. M. G.

A. The proper way to connect a motor starter is with the resistance in the armature circuit only. The resistance of the armature is very low, and if the motor is of any size above half a horse power the current that would pass through the armature in the act of starting would be very strong, if no resistance were used. As soon as the armature begins to revolve it sets up a back pressure that prevents the current flowing through it so freely. The object of the resistance is to keep the current strength down while the speed is building up. If the resistance is placed in the armature circuit only the full voltage acts upon the field coils, and thus the field is magnetized to its full strength from the very start. If the resistance were placed in the main circuit it would cut down the current through the field coils just as much as that through the armature, and the result would be that the field magnets would be so weak that the torque, or rotating force of the armature, would be too small to set it in motion unless running free. From this it will be seen that the placing of the starter resistance in the armature circuit not only acts to keep down the strength of the armature current in starting, but at the same time causes the full strength of field current to flow through the field coils and thus enables the armature to start off with a very strong torque; stronger, in fact, than it gives when running at full speed.

Early Ship Building.— The first ship built in this country is claimed to have been constructed on the banks of the Kennebec river in 1607. A party of colonists under the direction of Capt. George Popham landed on the Kennebec from the ships *Gift of God* and *Mary* and started a settlement and the following year built the ship *Virginia* of 130 tons.

Floating Dock for Odessa.—A floating drydock was recently built at Fuime, Hungary, for the Russian Steam Navigation and Trading Company, of Odessa, and has been safely towed to its point of destination. It is built in two parts, one part being divided into four pontoons and the other part into three pontoons, with a total lifting power of 4,800 tons. The dock is valued at about $403,000.

Transatlantic Freight. — The transatlantic steamship freight agreement went into effect on January 21st. The pool is the largest ever formed, and includes the White Star and Cunard lines, New York and Liverpool; Atlantic Transport Line, to Liverpool from New York, Philadelphia and Baltimore; National Line, New York and Liverpool; Leyland Line, from New York, Boston and New Orleans to Liverpool, and from Boston to London; the Wilson and the Phoenix Line, New York and Hull; Wilson-Furness and Leyland Line, Boston and London; Lamport and Holt Line, New York and Manchester; the American and Red Star Lines, New York and Southampton, Philadelphia to Liverpool and Southampton; The Philadelphia and Manchester Line, Chesapeake and Ohio Steamship Company, Newport News to London and Liverpool; Virginia Line, Norfolk to Liverpool and London, and the Dominion Line, from Boston to Liverpool. The new rates apply to three commodities only—grain, flour and provisions—and are only for outgoing freights shipped to England.

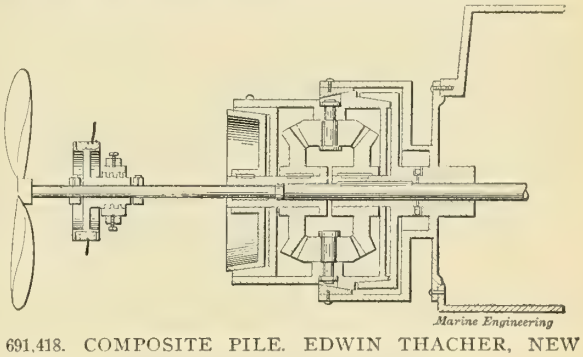
SELECTED MARINE PATENTS.

690,961. MANUFACTURE OR TREATMENT OF ARMOR-PLATES. BENTON K. JAMISON, PHILADELPHIA, PA.

691,254. MEANS FOR POSITIONING AND FIRING HEAVY ORDNANCE. THEODORE M. FOOTE, BROOKLYN, N. Y., assignor to Edwin H. Brown, borough of Manhattan, New York, N. Y.

691,258. SCREW-PROPELLED BOAT. HERMAN T. GAY, BALTIMORE, MD.

691,300. REVERSING APPARATUS FOR PROPELLER SHAFTS. JOHN TITUS, TOWNSEND W. BURT AND DANIEL D. SMITH, OYSTER BAY, N. Y., assignors to the Oyster Bay Engine Company, a corporation of New York.



691,418. COMPOSITE PILE. EDWIN THACHER, NEW YORK, N. Y.

Claim.—1. A composite pile having an upper portion of concrete, in which are imbedded a plurality of longitudinal metallic bars, a lower portion of wood, and means for splicing the two parts togethers. Three claims.

691,451. APPARATUS FOR INDICATING, RECORDING AND INTREGRATING THE SPEED OF VESSELS. CHARLES E. DELANOY, NEW YORK, N. Y., assignor to Delanoy Safety Log Company, a corporation of New York.

Claim.—1. In an apparatus for ascertaining the speed of vessels by the tension produced by a log, the combination of a lever-arm, a spring against which it acts, a line or cable for ap-

plying the tension to said lever-arm indicating mechanism connected to said lever-arm to indicate the rate of speed, and a means for reducing the movement or displacement of the indicating mechanism to correspond substantially to the square root of the applied tension. Four claims.

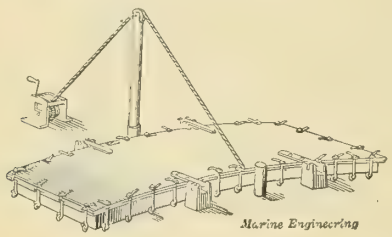
691,514. PROPELLER. WILLIAM O. WHITNEY, GLENS FALLS, N. Y.

Claim.—1. A propeller consisting of a hub and blades, each of which has the form of a cone section, the adjacent edges of said blades being secured to the face of the hub along spiral lines. Seven claims.

691,713. APPARATUS FOR RAISING SUNKEN SHIPS. MATIEU BOURHANOVSKY, LIBAU, and ALEXANDRE DE KOWANKO, ST. PETERSBURG, RUSSIA.

Claim.—1. In an apparatus for raising sunken objects, an inflatable receptacle provided with suitable inlet and outlets, tubes depending into said receptacle from said outlets, means for adjusting said tubes, a supporting cover mounted upon the receptacle, and means connected with the supporting cover for attaching the apparatus to the object to be raised. Nine claims.

691,752. HATCH-COVER. WINFIELD W. DAWLEY, GENEVA, OHIO.

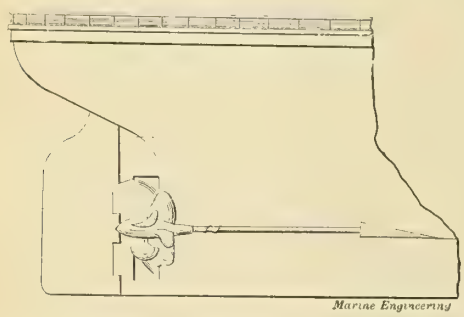


Claim.—1. The combination with a decked vessel having a hatch and a hatch-coaming therefor, of a hatch-cover extending over and beyond the hatch-coaming, angle-irons fastened to the under side of the cover and having outwardly extending horizontal members lying snugly gainst the cover, and vertical members extending downward inside of the hatch-coaming, a packing-gasket secured to the under side of the horizontal member of the angle-iron, and bearing on the hatch-coaming, transversely-projecting arms fastened to the hatch-cover and extending beyond the same and provided at their ends with trunnions, and stanchions fastened to the deck, and having bearings therein for the reception of the trunnions. One claim.

691,792. SCREW-PROPELLER. FRANK C. METZ, ALLEGHENY, PA.

692,001. APPARATUS FOR RAISING SUNKEN VESSELS. JOHN BARKER, SEATTLE, WASH.

692,117. MARINE PROPULSION. ISAAC M. CHASE, WASHINGTON, D. C.



Claim.—1. A screw-propeller, in combination with fixed guide-blades aft of, surrounding, extending forward and terminating at approximately the longitudinal center of the screw.

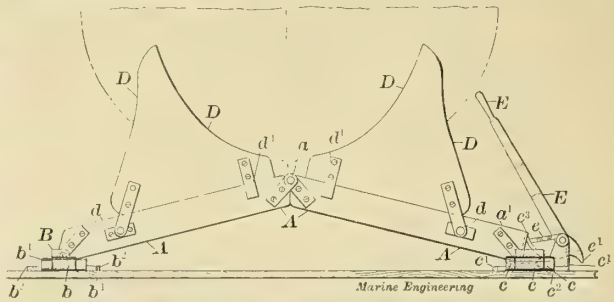
2. A screw-propeller, in combination with fixed guide-blades aft of the screw, and having a pitch and a curve from the root to the tip of the blade approximately the pitch and curve of the screw. Eight claims.

692,355. APPARATUS FOR LOADING OR UNLOADING BULK CARGOES. ALEXANDER W. ROBERTSON, LONDON, ENGLAND.

Claim.—1. The combination with a pontoon of a movable carriage secured thereto, means for securing a floating vessel to said carriage, and means for transferring the bulk cargoes of said floating vessel, as set forth. Fifteen claims.

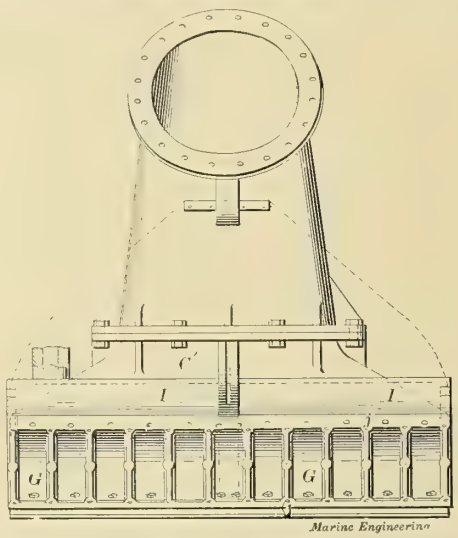
692,400. MEANS FOR DISENGAGING AND REPLACING THE SUPPORTS OF BOATS ON SHIPS, ETC. THOMAS WILSON, SUNDERLAND, ENGLAND.

Claim.—1. Means for disengaging and replacing the supports of boats on ships and elsewhere, comprising bars or supports A, A carrying chocks D, D, hinged together endwise so as to be angled or distended, and capable of being tilted or turned over to one side, and a lever E upon the deck or other place for effecting or controlling said movements, substantially as described and shown.



2. Means for disengaging and replacing the supports of boats on ships and elsewhere comprising bars or supports A A, a bracket B pivoted to the deck or other support and having a pivotal connection with one of the said bars, and a guide-bracket C similarly pivoted to the deck or support, the other end of the other bar or support A being mounted in said guide-bracket C, whereby the arms or supports, when distended, can be tilted over to one side free from the boat, substantially as described. Seven claims.

692,815. MOUTH-PIECE FOR SUCTION DREDGES. LINDON W. BATES, CHICAGO, ILL.



Claim.—1. A mouthpiece for trailers of suction-dredges provided with a cutting edge; and a series of water-jets located in a plane above said cutting edge, and arranged to act in conjunction therewith, said jets being directed outwardly in substantially parallel lines, with said edge away from the mouthpiece. Six claims.

692,910. PROPELLER FOR VESSELS. DETLEF H. ROHWEDDER, CHICAGO, ILL.

692,973. HYDRAULIC DREDGE. LINDON W. BATES, CHICAGO, ILL.

Claim.—1. In combination with the discharge pipe of a dredge, a baffle-plate adapted to receive the impact or pressure of the outflowing current from said pipe, said baffle-plate having two diverging faces, and being greater in depth at its extremities than at the point of junction of said faces. Five claims.

693,228. BOAT ADAPTED TO BE PROPELLED ON LAND OR IN WATER. SAMUEL T. BRITTAIN, BOSTON, MASS.

693,242. APPARATUS FOR CLEANING BOTTOMS OF SHIPS. ROBERT S. CULPEPPER, HOUSTON, TEXAS, assignor of two-thirds to Abnus B. Kerr and Ira M. Bryce, Houston, Texas.

Claim.—1. A cleaning device for ships' sides and bottoms, having a jet-nozzle opening in opposite direction to the operating face of the cleaning device to hold the latter up to its work, and means for moving the cleaning device over the ship's surface substantially as described.

2. A cleaning device for ships' sides and bottoms, consisting of two separate brushes. Four claims.

693,272. AUTOMATIC DRIVING MECHANISM FOR SUBMARINE BOATS. JOHN P. HOLLAND, NEWARK, N. J.

Marine Engineering

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U. S. NAVAL WAR COLLEGE LIBRARY 1902

REPAIRS AND ALTERATIONS TO THE U. S. S. OLYMPIA.

BY WILLIAM P. ROBERTS, NAVAL CONSTRUCTOR, U. S. N.

Among the vessels recently fitted out at the Boston Navy Yard, is the first class protected cruiser *Olympia*, made famous as the flagship of Admiral Dewey in the battle of Manila Bay.

It is interesting to note the rapid strides in the art of shipbuilding, not only as affects the under-water and above-water form of a vessel, the water-tight subdivision, the layout and disposition of armor, armament, machinery, coal and stores, but more especially as concerns the remaining features that go to complete the vessel and make the most of the space allotted for each particular purpose aboard ship. After the *design* of a vessel, in its primary sense, is determined and the ship, as a floating body, is built, with its enormous watertight subdivisions, and its armor and guns are decided upon, its engines, boilers and propellers installed, there still remain numberless details, large and small, upon which depend, both directly and indirectly, the efficiency of the vessel as a fighting machine. In fact, it may be said that the ultimate efficiency depends much more upon these details than upon the first layout of the design, however necessary the latter is as a foundation. It is particularly in the matter of these many details, which may be summarized as interior fittings, that rapid improvement and changes in warship construction are being effected at the present time. During the past decade, the principal sea powers have been building warships, all of which, class for class, resemble each other on paper; that is, so far as concerns their principal dimensions, their water-tight subdivisions, their disposition of armor, guns and machinery. But a visit aboard the various vessels built ten or even five years apart, or even on vessels built by different nations at the same period, reveals a very apparent dif-

UNITED STATES PROTECTED CRUISER OLYMPIA.

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ference; this difference can even be noticed among so called "sister ships," when built at different yards. In the building and fitting of vessels of the United States Navy, it is only by the exercise of extreme care on the part of central authorities at the Navy Department, as well as of the Department's local representatives, that anything like homogeneity and standardization in the large field of interior fittings is approached. The generally accepted definition of efficiency is connected with the idea of maximum output with minimum input; but when this word is applied to a man-of-war, and particularly to the individual parts, the word should in addition carry the idea of *certainty of operation when called upon to perform the functions for which it was designed.* Thus the care that a device will receive, the intelligence of the operator, and its accessibility to receive frequent overhauling and inspection, are features that should receive great consideration in the installation of fittings in a vessel.

It is quite right that in the primary design of a warship the offensive and defensive features should be solely considered, the battery being so laid out that the maximum amount of destructive gunfire can be concentrated against the enemy in any direction, the armor and water-tight bulkheads so disposed that the maximum protection is secured, and the propelling machinery and fuel being such that the maximum speed and radius of action compatible are obtained. But, when these primary fighting qualities are settled, it is of the utmost importance that the officers and crew that are to be housed in the small remaining space available be made as comfortable as possible, so as to be in fit condition to get the best results out of the machines they handle. Considering the men merely as *machines*, it is of as much importance that they be kept in mental and physical health as it is that any *other* machinery aboard ship be kept in repair and working order. Therefore, if we are to build warships that excel those of foreign powers, it must be by providing the best weapons and ensuring that the personnel that are to handle them be kept in fitness for the best results. In the necessarily cramped quarters that the officers and men are provided with, it would be a short-sighted policy to provide other than the most comfortable environments, when efficiency is not otherwise involved. It is a notable fact that more attention is paid in the United States Naval service to the comfort of all hands than in the service of any other nation, not even England excepted.

In view of the importance of the fittings of a vessel, it is not surprising that changes in this direction should be both rapid and at times radical, and that standardization should be a difficult matter except in minor details. In reference to the *Olympia* the question may be asked, Why should a steel vessel of this type, which was only completed in '95, and which was evidently quite fit for battle in '98, be laid up for extensive repairs? The answer is, In order that the internal fittings and auxiliaries above referred to, on which the fighting efficiency so largely depends, may be put in thorough repair and modernized. The importance and extent of this work can hardly be realized without actually following its progress through the various stages; the absolute interdependence of fittings upon each other in cramped and crowded spaces is such that the disturbance of one fitting generally causes far-reaching results in connection with its neighbors. These results can be anticipated only after careful experience in such work.

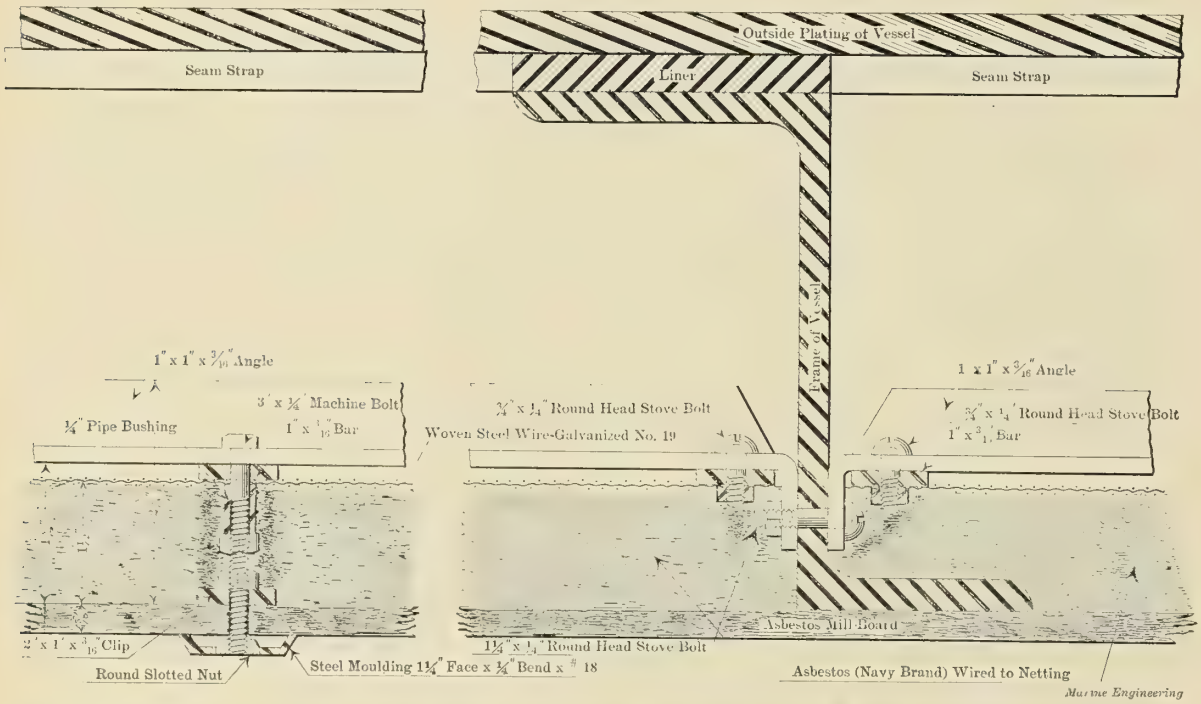

Seam Strap
Outside Plating of Vessel
Liner
Seam Strap
Frame of Vessel
1" x 1" x 3/16" Angle
3/4" x 1/4" Machine Bolt
1/4" Pipe Bushing
1" x 1/16" Bar
3/4" x 1/4" Round Head Stove Bolt
Woven Steel Wire-Galvanized No. 19
1 x 1" x 3/16" Angle
3/4" x 1/4" Round Head Stove Bolt
1" x 3/16" Bar
Asbestos Mill Board
2" x 1" x 1/16" Clip
Round Slotted Nut
Steel Moulding 1 1/4" Face x 1/4" Bend x # 18
1 1/4" x 1/4" Round Head Stove Bolt
Asbestos (Navy Brand) Wired to Netting
Marine Engineering

FIG. 2. METHOD OF FITTING ASBESTOS SHEATHING AGAINST THE SIDES OF THE VESSEL IN OFFICERS' QUARTERS.

The *Olympia* was built by the Union Iron Works, San Francisco, and was first commissioned in February, 1895. She is officially known as a "protected cruiser;" she carries four 8-inch breech loading rifles in barbette turrets, the barbettes being 4½ inches thick (Harveyized steel); there are also ten 5-inch rapid fire guns, mounted in sponsons (4 inches thick) on the gun deck, and fourteen six pounders in sponsons (2 inches thick) on the berth and superstructure decks; also six one pounders, one Colt's automatic, and one Gatling on the superstructure and in military tops. The protective features of the vessel include an armored conning tower, also a protective deck 4 3-4 inches thick on the slopes and 2 inches on the flat. The waterline is protected by a cofferdam, packed with fireproof cornpith cellulose; the coal bunkers furnish, also, a further protection at the waterline.

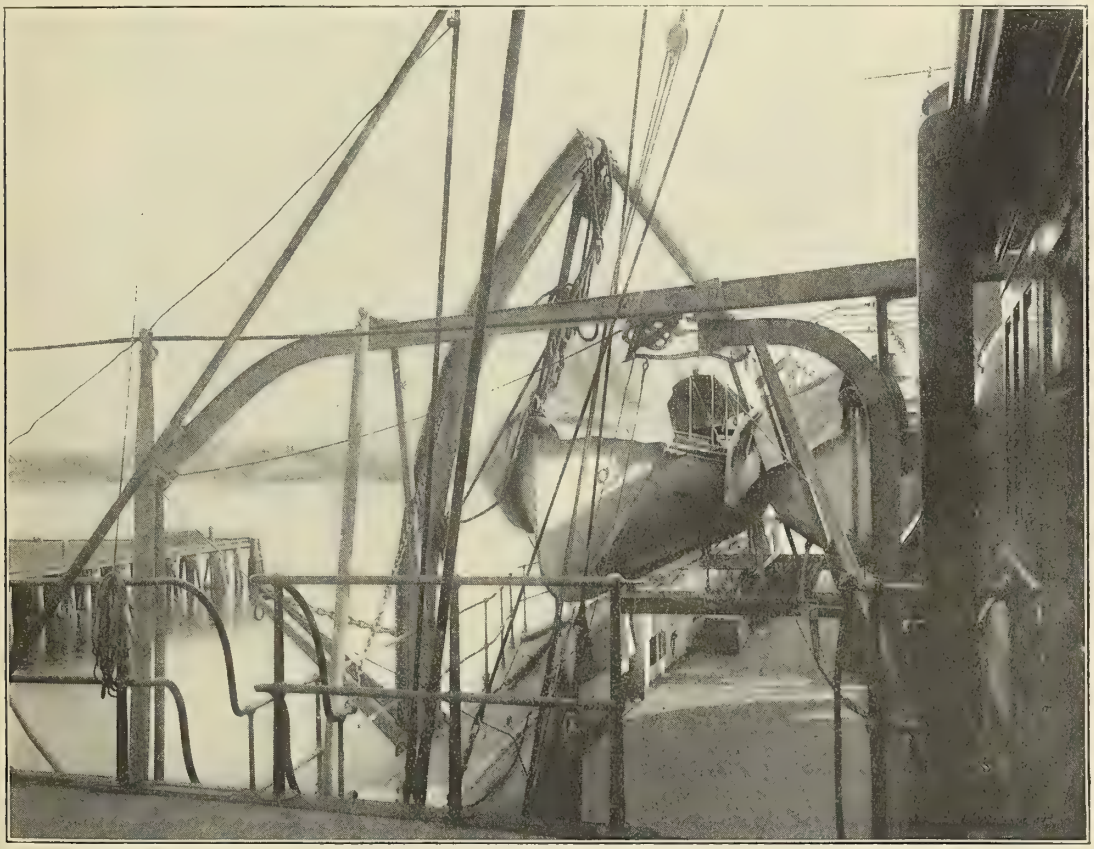


FIG. 3. SPECIAL COAL HANDLING TROLLEY.

The *Olympia's* principal dimensions are as follows:—

Length, load waterline	340	ft. 0 in.
Breadth, extreme	53	" 5⅝ "
Normal Draft, forward	20	" 6 "
Normal Draft, aft	23	" 6 "
Normal Displacement	6 050	tons
Full load Displacement	6,800	"

She has cylindrical boilers, with vertical triple expansion engines, operating twin propellers. She carries 1.153 tons of coal, and has a steaming radius of about 6,000 miles. Her complement as a flagship is 34 officers, 412 crew and 40 marines.

Some of the more important items of work in connection with the recent refitting of the *Olympia* are given below. It is interesting to note the bearing, either direct or indirect, of each of these items on the ultimate qualities of the ship as a weapon—a fighting machine, self-contained, resourceful and always ready for any call that may be made upon its services in any climate, and at any distance from its base of supply.

The vessel was stripped of all furniture and of all sheathing against the bulkheads and inner surfaces of the ship so as to allow the entire steel hull, both inside and outside, to be scaled, the thick accumulation of paint being removed, together with any rust that existed. New paint was then applied to these surfaces. The magazines and storerooms were resheathed with wood battens after certain of their bulkheads were altered to provide an improved arrangement and stowage of ammunition.

All of the six above-water torpedo tubes were removed, and their openings through the sides of the vessel closed; the spaces formerly occupied by these tubes are now utilized as additional crew space and storerooms.

The turret tubes or columns, by means of which the turrets are turned, and through which the ammunition is hoisted to the turrets, formerly extended only to the platform deck, and all of the ammunition had to be placed in the hoist at this deck. These tubes have now been extended down to the hold, where all of the eight-inch ammunition is located, and suitable trol-

leys are provided for bringing this ammunition to the hoist entrance. The hoists in these turrets have been entirely remodeled. As fitted formerly there was an electric motor located in the after end of the turret, operating a single ammunition car by means of a wire rope; this rope led over sheaves on a crane which pivoted so that the sheave, from which the car suspended, could be swung directly over the loading position of either gun. All of this mechanism was removed. The new hoist consists of two cars, one on each end of a wire rope which leads over sheaves in the top of the turret and around a drum which is geared to an electric motor located in the port side of the turret. As one car is hoisted the other lowers. The car is arranged with a stop at the upper end of the ammunition tube, and abaft this upper position of the car is a table on which the shell is drawn from the car and pivoted to the loading position.

One of the most important of all the changes on this vessel is the introduction of electric power for turning the turrets. They were formerly turned by steam, but the use of electricity, for this purpose, having proved so eminently successful on the *Kearsarge* and *Kentucky*, its introduction on the *Olympia* was by no means an experiment. The delicacy of train, as well as the rapidity and certainty of action, which can be obtained with electricity, make it the favorite power for this as well as for many other uses on board warships.

Each turret is provided with two motors of 20 K. W. each, each motor being directly connected to a worm shaft; these worms work in a gear which is secured to the central tube or column of the turret, the two worm shafts being cross connected by means of bevel gears to ensure that the two worms always operate to produce identical results. The specifications for the electric installation of these turrets require nine different speeds at which they can be operated, the fastest being at least 6½ degrees per second for the rotation of the turrets. There is provided a tripping device for automatically bringing the controller to the *off* position so as to stop the turret at its position of extreme train on either side. The great delicacy of train, obtained by the use of these motors, renders the guns carried in the turrets much more effective weapons than they were formerly. Effective gunfire being the primary object of a warship, the value of a mechanism for delicate and accurate training of the guns cannot be overrated.

In refitting this vessel much care has been used to ensure that the living spaces be made habitable in all latitudes. The sides of the old wooden war vessels, in many instances, consisted of several feet of thickness of solid oak, thus forming an excellent protection inside against extremes of heat and cold occurring outside. In modern warships, however, the steel hull is only a fraction of an inch in thickness, and while it excludes water it does not prevent rapid changes of temperature in accordance with the temperature outside. These changes also cause "sweating" to take place inside the vessel, the effect being unhealthy and otherwise unpleasant quarters for living. For many years a sheathing of wood has been applied to the inner surface of the frame angles in officers' quarters, thus creating an air space of several inches in thickness. Similar results were obtained in crew-spaces, pantries, etc., by the use of thin sheet iron to form the sheathing, although the nonconducting properties of the combined air space and sheathing are not so great in the latter case as with the use of wood sheathing. In refitting certain ships of our Navy, and in the construction of certain new vessels, asbestos lining has been largely used for sheathing the sides of living spaces. The results have been very satisfactory, a more even temperature being maintained in this way than by any of the former methods. Apart from the nonconducting properties of asbestos, it commends itself for use on warships on account of its fireproof and nonsplintering qualities.

In the case of the *Olympia* asbestos has been used in the officers' living spaces, and its use has also been extended to certain other spaces where it is particularly applicable; notably in the engine and boiler room trunks, and on the under side of the beams that support the deck of the dynamo room, magazines being located under this room. All sides of the midship magazine were also sheathed with asbestos, and the air space thus provided was fitted with special supply and exhaust pipes connected with the ventilating blowers to ensure a frequent change of air and consequent reduced temperature.

The method of fitting this asbestos sheathing against the sides of vessels is shown by reference to Fig. 2. A background, consisting of a wire netting, is secured to a framework of small angles. On this netting are fitted sheets of asbestos firefelt, 1½ inches in thickness, being held against the screen by means of washers secured to the netting by wire. Against this surface of asbestos firefelt are fitted sheets of asbestos millboard, 5-8 inch in thickness, the seams of which are covered with strips of steel moulding, the latter being secured by means of bolts previously fitted in place through the small angles forming the framework. The nuts on these bolts are countersunk and rounded, and the sheathing, thus finished, presents a neat appearance of panelwork.

In fitting this sheathing in other than living spaces, the millboard is omitted and its place supplied by galvanized sheet iron, through bolts with common nuts being used to secure the sheets to the angle iron structure. This method is simpler, and less expensive, than that used in the living quarters.

The cruising powers of a vessel at any time being so largely dependent on the amount of coal to be found in her bunkers, and her maximum speed being dependent on the rapidity and ease with which this coal can be transported to the firerooms, it is necessary that the best possible arrangements be provided for rapidly getting the coal aboard and in the bunkers, whether from a collier at sea or from a lighter or wharf alongside. The bunkers being subdivided into many compartments (for safety in case the hull is perforated in action), the rapid transportation of coal from the more distant compartments to the firerooms becomes a problem worthy of careful consideration. In the *Olympia* an overhead trolley has been run in the wing passage on each side, the length of the upper

bunkers. By this means coal from any upper bunker can be rapidly carried to the scuttle over any lower bunker on the same side of the vessel, and thus to any fireroom.

In coaling the ship formerly, all coal had to be placed aboard through hinged chutes or "cheese ports" through the sides of the vessel. The rapidity of coaling has been largely increased during the present refitting by the installing of four special coal trolleys, located above the superstructure deck and arranged for coaling over all. One of these trolleys is illustrated in Fig. 3. Each trolley carriage runs on an I beam whose inner end is located near the center line of the ship, and whose outer end is well rounded down and extends about five feet over the side of the vessel when rigged out. Near the outer end of this beam it is supported by means of a large A frame, through which this trolley carriage and the bags of coal are required to pass. The lower ends of the stanchions which form this A frame are hinged, so

FIG. 4. BOW VIEW OF U. S. S. OLYMPIA SHOWING COAL HANDLING TROLLEY IN USE.

that the entire beam can be rigged in and carried with its end clear of the ship's side when not in use. In coaling ship with these trolleys the coal bag is hoisted by means of a wire pennant, whose inboard end is secured to a loose drum on a winch. This drum is thrown in gear by a friction coupling, and when the bag is raised and run in to its proper position, over the large square hatches, it is lowered by means of a friction band operated by a foot lever. These hatches, one set under the lowering position of each trolley, extend through the superstructure and gun decks, and the bags of coal, as they are lowered, land on trucks and are thus transported to the various coal scuttles over the bunkers. The winches are continuous in motion, not being reversed while used for getting in and lowering coal, the lowering being operated entirely by gravity and controlled by friction. The cheese ports can be used for coaling through the sides at the same time that the trolleys hoist coal over all.

These trolleys have been found to give good satisfaction, having been used in the first coaling of the vessel as she fitted out. The working of the trolleys can be further studied by a reference to Fig. 4, in which one of them is shown in the act of hoisting a bag of coal.

The deck winches referred to above are new, none having been provided with the ship's first outfit. They are two in number, each being provided with a gypsy on each end for hoisting boats and other weights, and each winch also having two loose drums (above mentioned) for use in hoisting coal. The winches are on the superstructure deck, and their shafts, as usual, extend athwartship. Each winch will alone hoist the heaviest boat carried on this vessel (33 foot steam launch). Thus installed they have proved very satisfactory.

The artificial ventilation system of the ship has been entirely remodeled in accordance with modern practice, and it is now much more efficient than formerly. The system formerly consisted of two large steam driven blowers, located in the after end of the crew space on the berth deck. The piping and trunks used for distributing the fresh air throughout the ship were necessarily very great in length and large in area in order to allow the necessary volume of air. This required many large openings throughout water-tight bulkheads and decks, reducing the effective watertightness of such compartments. The great lengths of piping traversed by the air, together with the many turns and other obstructions in the same, were also such as to cause great loss of velocity and reduced efficiency. In recent vessels of our Navy it has been the practice to use a large number of blowers in ventilating the various compartments. By this means a small group of compartments is ventilated by means of a blower centrally located with reference to that group; the leads of pipes are short, the pipes themselves are small, and no large openings need be cut in bulkheads. The use of automatic valves where bulkheads are pierced is almost, if not entirely, eliminated. The blowers being run by electricity, the objectionable features incident to engines and steam piping in crew spaces, passages, etc., are also eliminated. The *Olympia* now has nine electrically driven blowers, as follows:—

Two in the dynamo room to supply fresh air to that room, and to the magazines under the same.

Two on the platform deck, over the dynamo room, to exhaust foul air from the dynamo room and from the various compartments on the forward berth deck, forward platform deck and the storerooms forward.

Two on the after berth deck to supply fresh air to the main crew space, to the junior officers' and warrant officers' quarters, and to the various pantries, closets, bath rooms, washrooms, etc., on the berth deck as far aft as the wardroom messroom; the distiller room, funnel rooms and midship magazine are also supplied with fresh air by these blowers.

Two on the after platform deck to supply fresh air to the wardroom, staterooms, bathrooms, etc., also to the after storerooms, magazines, tiller room, and other compartments under the wardroom.

One blower is located under the after end of the dynamo room, and exhausts hot and foul air from the forward magazines, special exhaust ventilation being necessary for these magazines, on account of their proximity to the firerooms and the dynamo room.

In addition to these blowers, the ventilation of the *Olympia* has been further improved by the introduction of additional trunks and cowls for the supply of fresh and the exhaust of foul air. The firerooms are provided with special steam blowers for ventilation and for forced draft; the engine rooms have special trunks with cowls for supplying fresh air, the hot air being exhausted through the main engine room hatches and through other trunks provided for the purpose.

The coal bunkers are supplied with fresh air through trunks that end at the hammock berthing on each side of the superstructure, these trunks having branches that lead to the various bunkers. The hot air from the bunkers is exhausted through other systems of piping which combine in trunks that lead up through the main funnel hatch.

The firemain has been practically renewed as well as much extended; a new feeder main has been run under the protective deck, which forms, with the main under the upper deck, two principal lines of feeders. These mains are connected together at suitable intervals by risers, and are supplied by two main fire pumps, one in each engine room outboard adjacent to a seacock. They can also be supplied by each of the four auxiliary fire and feed pumps in the boiler rooms, and also by the three hand deck pumps. Gate valves are fitted at suitable intervals in the firemain piping so as to enable such portions as may be injured in battle to be shut off and the remainder utilized. The firemain system is fitted with 30 connections for fire hose. The firemain is also connected with the distilling plant and with the flushing main.

The firemain and all of its risers and branches are of heavy copper pipe, having a coating of black Sabin enamel inside. This enamel has recently been used, with good results, in the case of pipes that are to be continually or periodically flooded with salt water. Iron or steel pipes, unprotected, are found to deteriorate rapidly by corrosion and galvanic action

when used for salt water service. For this reason copper piping has generally been used for firemain service aboard ship, it being of the utmost importance that the piping be always serviceable and capable of withstanding considerable pressure. However, under service conditions, copper pipes, unprotected inside, will deteriorate in time, and some cases of rapid wasting have recently been noticed. The use of enamel in this connection is expected to lengthen greatly the life of the firemains. Asphaltum has also been used with good results in similar cases, although not on this vessel.

The fresh water piping system in this vessel has been entirely renewed and remodeled to suit the somewhat altered conditions of the quarters, pantries, etc. Fresh water service has been provided in each stateroom, automatic closing valves being provided over each wash bowl. All the fresh water piping and fittings are of iron, tin-lined inside, except the smallest service pipes, which are of brass.

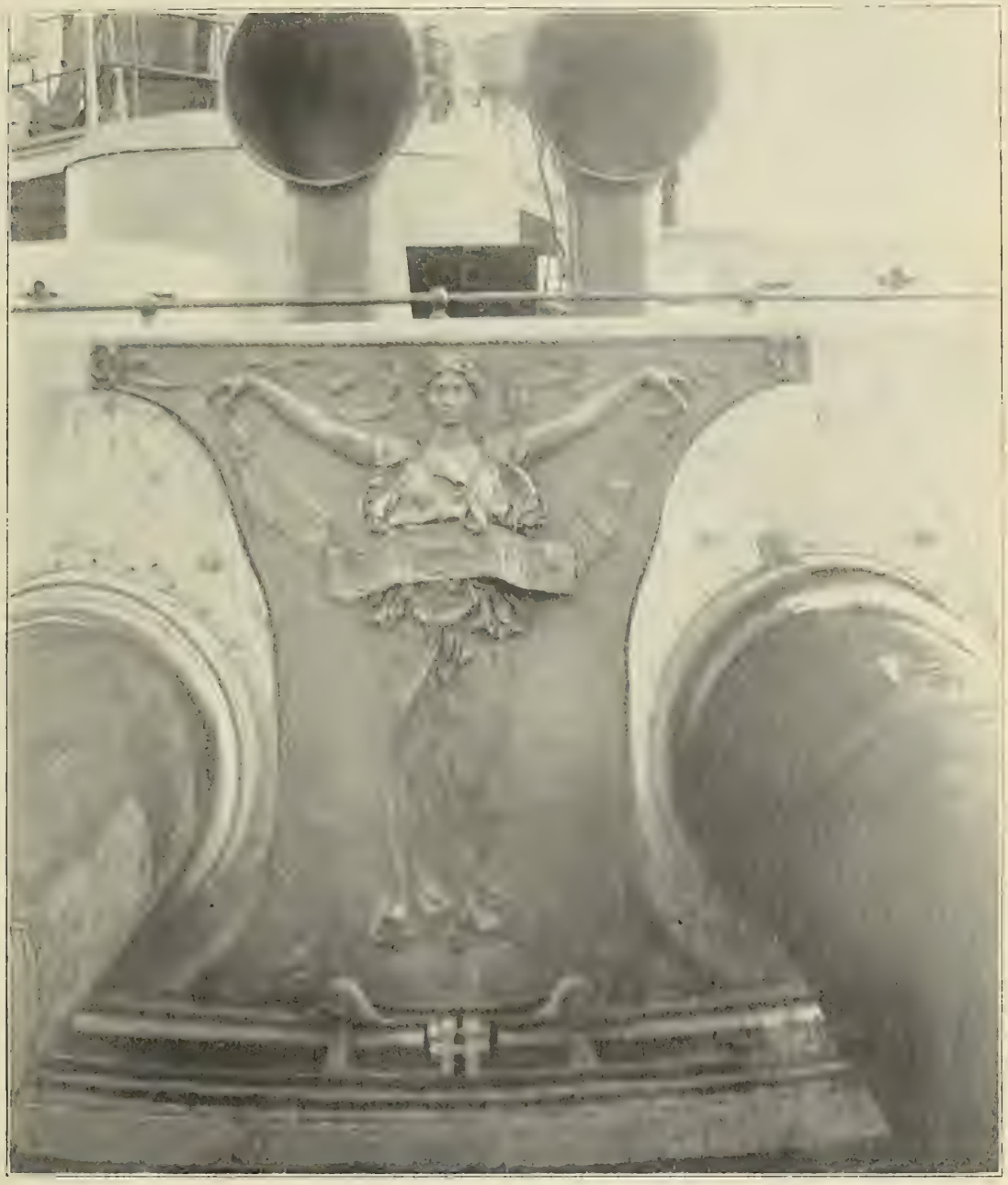


FIG. 5. PLATE PRESENTED TO THE U. S. S. OLYMPIA TO COMMEMORATE THE BATTLE OF MANILA BAY.

The flushing system is of iron, lead-lined inside; all drains from baths, closets, sinks, etc., are of brass. The piping used for fresh water and salt water services is designed to combine the best possible service with long life to the material. All of the plumbing is new. The secondary drains and piping in connection there-

with are also new, being of extra heavy steel pipes galvanized.

Many of the speaking tubes have been renewed, and the service greatly extended.

The standard compass platform, which formerly occupied so prominent a position, high in air, over the conning tower, has been removed, and a new platform built immediately forward of the after bridge and connecting with it. The platform of this bridge is insulated from the brass stanchions supporting it, and the hand railing and its stanchions in the vicinity of the platfrom are of wood, care being thus taken to guard against stray currents which might affect the compass.

tilling plant has been materially enlarged, also an auxiliary condenser has been provided in the dynamo room for the use of the generator engines. Considerable new steam piping was necessitated in connection with the installation of the increased electric plant.

The total rated output of the *Olympia's* generators, on her previous cruise, was 64 K. W. (four generators of 16 K. W. each). This has been increased to 176 K. W. (four generators of 32 K. W. each, and two of 24 K. W. each). These generators are all in one compartment under the protective deck, being grouped three on each side, the forward turret column with its motors and gearing for turning, being located in the middle of this compartment. The in-

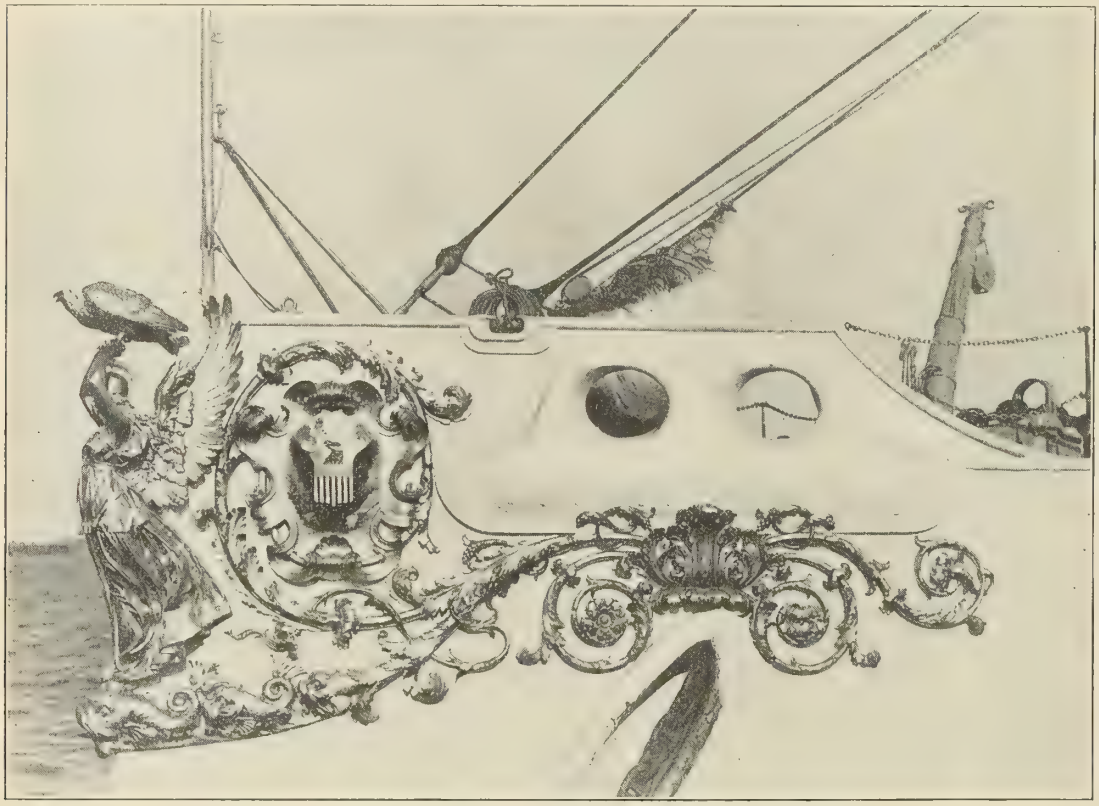


FIG. 6. BOW ORNAMENT WITH SEAL OF THE UNITED STATES.

An additional signal house has been built abaft the after bridge and on a level with it; this house is designed for the use of the commander-in-chief when sailing in squadron; it is fitted with wide transoms which can be used as berths, and is also fitted as an office. This signal house is in a prominent position, and is sufficiently large (about 12x14 feet) to affect the appearance of the vessel. The mainmast being immediately adjacent to this house, it was necessary to remove the lower top, which was formerly used as a searchlight platform.

The alterations in the engineering department have been comparatively few. All parts of the boilers and engines, including all auxiliaries, also all piping, valves, shafting and shaft bearings, have been carefully overhauled and repaired, so that the entire steam plant is in thoroughly first-class condition. The dis-

creased electric power for this vessel is required principally for the turning of turrets, and for the nine electric blowers, the ship being formerly (as at present) provided with electric hoists for ammunition and with electric lighting and searchlights.

A complete system of battle order and range transmitters, indicators, fire alarms and thermostats has also been installed.

Most of the feeders carrying electric current are located below the protective deck, and are run in iron conduits insulated inside. This insures greater protection than by any other means in common use.

All of the cofferdams were emptied of the cocoa fibre cellulose and refitted with fireproof cornpith cellulose, after the compartments were thoroughly scaled and painted.

In refitting the staterooms, offices and messrooms,

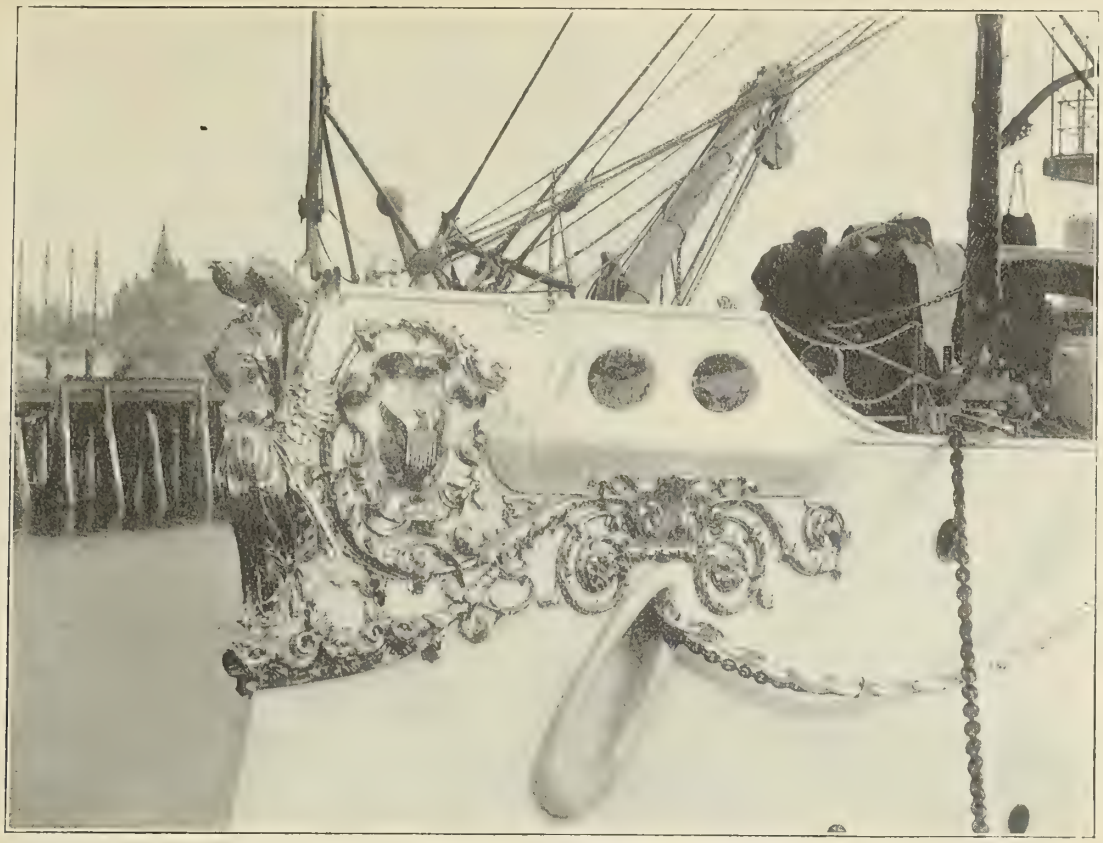


FIG. 7. ANOTHER VIEW OF BOW ORNAMENT.

FIG. 8. STERN ORNAMENT, U. S. S. OLYMPIA.

it was found necessary to make certain changes to provide for the altered complement of officers. Fewer junior officers and more warrant officers are now carried on vessels of this class than formerly. It was necessary to provide suitable messroom, pantry and staterooms for the warrant officers, provision being made for eight. In refitting the quarters, corrugated sheet iron bulkheads athwarship were used between staterooms in place of the wooden bulkheads formerly used. The wood bulkheads fore and aft, inboard of the staterooms, were fitted to button in place, so as to be portable; by this means these wooden bulkheads can be readily removed in case of war, and their places supplied by canvas screens; these, with the iron athwartship partitions, will present much better fireproof qualities than were possessed formerly.

In refitting a vessel of such historic interest as the *Olympia*, it was thought appropriate to perpetuate the memory of her good work by incorporating into the hull of the vessel figures and lettering of more than usual ornamentation. The vessel is accordingly fitted with the following:—

On the forward side of the after bridge are secured two plates inscribed in plain lettering, easily read the length of the deck, "Manila Bay, May 1, 1898."

On the forward turret between the two gunports is a bronze tablet bearing the historic words, "Gridley, you may fire when ready." This tablet was presented to the ship by the City of Olympia and the State of Washington. A photograph is reproduced in Fig. 5.

The *Olympia* is fitted with bow and stern ornaments more elaborate in design and workmanship, and more striking in effect, than those on any modern vessel in our Navy. The bows of modern warships have generally been ornamented with a simple shield secured to the stem and curved on either side to follow the lines of the bow. In the case of the refitting of the *Cincinnati* (at the New York Yard) and the *Olympia* (at the Boston Yard) there has been a tendency to return to the practice in vogue in the days of wooden shipbuilding, when figureheads were such in more than name. The December, 1901, number of Marine Engineering contained reproductions of photographs of the bow and stern ornaments of the *Cincinnati*. Figs. 6, 7 and 8 give corresponding photographs of the *Olympia's* ornaments. These differ from the *Cincinnati's* only slightly in general design, the seal of the United States being used on the *Olympia* where the seal of the Navy Department is to be found on the smaller cruiser. The *Cincinnati's* ornaments were part of bronze and part of wood, whereas the *Olympia's* are of bronze throughout, the eagle at the bow being cast entirely from metal which formed a part of the operating gear of the torpedo tubes carried on the vessel during the battle of Manila Bay, the other parts of the bow and stern ornaments containing a portion of similar historic metal. The bold lines of the winged figure of victory, wearing the helmet and breastplate of Minerva, are well brought out in the photographs (Figs. 6 and 7). On the uplifted hands is poised the

FIG. 9. SILVER SERVICE PRESENTED TO THE U. S. S. OLYMPIA BY THE CITIZENS OF THE STATE OF WASHINGTON.

American eagle, about to fly. The Victory stands over a line of dolphins and seaweed, which trail aft and up in graceful lines, ending in acanthus leaves. The whole ornament is symbolic of American freedom, gained by prudence and courage, and suggests the prominent part taken by our infant navy in the victories that were the making of the nation. The entire ornament extends from the bow aft a distance of thirteen feet on each side. In order to prevent the possibility of the figure being chafed or otherwise damaged by the vessel's cable when riding at anchor, a hawse pipe was fitted below the ornament, the old hawse pipes being above, as can be seen in the photographs.

The stern ornament is less elaborate than that at the bow, but is very effective. Around the nameplate is graceful scrollwork, warping closely against the stern of the vessel. The top of this scrollwork folds into a large cartouche on which are mounted a spread eagle and the United States shield. Against the scrollwork on either side is a boyish figure, supporting the helmet of Mars. The foliage of acanthus is used with good effect in the stern ornament as well as in that at the bow. Fig. 8 gives a good view of the stern of this vessel.

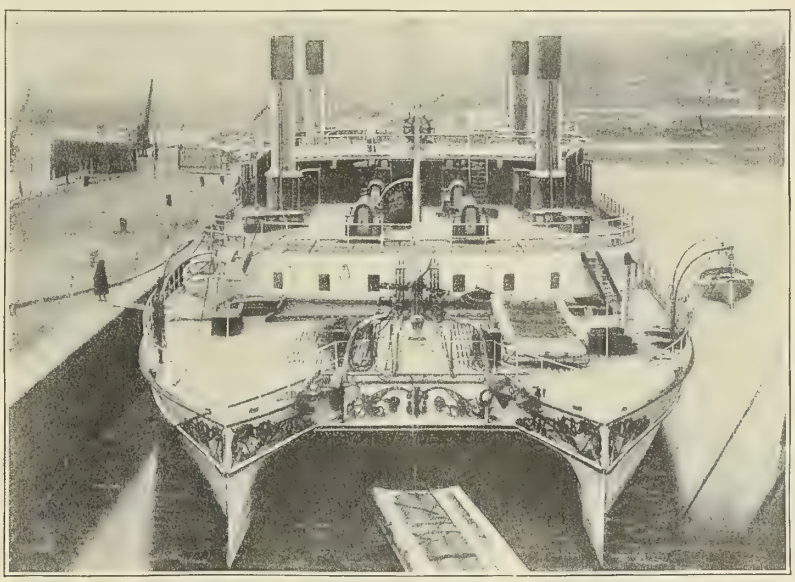
Fig. 9 is a photograph of the silver service, presented to the *Olympia* by citizens of the State of Washington, after her return from Asiatic waters. The cabinets in which this silver is stowed occupy prominent spaces in the Admiral's and Captain's cabins. The wood of which the cabinets are constructed formed a part of the ship before she was refitted.

American Schooners.—According to Mr. John S. Rand, of Portsmouth, N. H., there are 377 schooners of over 500 gross tons register owned on the Atlantic coast

An Old Channel Steamer.

An interesting steamer was built for the English Channel service in 1875 by the Thames Iron Works. At this time many proposed plans were suggested by naval architects, whereby the horrors of sea sickness in the hours of the Channel passage might be reduced, and the *Castalia*, as here illustrated, was actually built. As is seen, her hull is in halves, the same as if two longitudinal bulkheads were placed in a vessel, and the ship cut in two, fore and aft.

The dimensions of the *Castalia* were: Length, 290 feet; beam of each hull, 17 feet; designed draught 6 feet 6 inches. The two hulls were rigidly connected by a superstructure 168 feet long and 60 feet broad. Transverse stiffness was given by four engine and boiler room bulkheads, the continuation of these bulkheads above the hulls, holding in a large measure the two parts together.



OLD ENGLISH CHANNEL STEAMER.

The propelling power consisted of two pairs of direct acting diagonal engines, the cylinders being 46 inches diameter, 4 feet 6 inches stroke. The first set of boilers, owing to severe priming, was replaced by four boilers of 12 feet diameter. The designed indicated horse power was 1,250, which should have given the vessel a speed of 14 knots; but owing to the added weight of new boilers the draught was increased to 7 feet, thus increasing the already large skin resistance, so that on trial although 1,516 horse power was indicated a speed of only 11 knots was obtained.

The *Castalia* for a time attracted much attention and secured a large part of the passenger travel in the summers of 1876-'77. It is reported that she was a very steady ship, but her slow speed finally debarred her from this service.

The above facts, together with the illustration, are taken from *The Engineer*.

STEAMER SATURN OF THE GREAT LAKES.

RECENT OPERATIONS IN THE SHIPYARDS ON THE GREAT LAKES.

BY WALDON FAWCETT.

Many circumstances combine to make notable the record of steel ship building on the Great Lakes since the dawn of the century. Most important of these, perhaps, have been the new conditions growing out of the formation of the great industrial combination known as the United States Steel Corporation. The fact that this new giant of the industrial world controls a very large proportion of the iron ore transported by water from the Lake Superior district, and which really forms the backbone of lake traffic is of itself an important factor, but presumably farther reaching in its influence was the fact that the Steel Corporation from the date of its inception abandoned the policy of making constant additions to the ore-carrying fleet which had been followed very energetically by the principal component companies during the few years prior to the formation of the combination. However, contrary to general expectation, there has been no stagnation in the shipbuilding industry on the inland seas. The individual vessel owners, who were apparently to be driven from the field by the steady encroachments of the powerful producing interests, have taken heart, and the commissions which they have placed with vessel builders enabled the record of new construction during the first year of the new cycle to compare most favorably with that of any twelve month during the past decade.

At the opening of the year 1901 there were building or under contract at the shipyards on the Great Lakes a total of sixty-one vessels with an aggregate valuation of $12,535,000. With few exceptions all of these vessels were completed, delivered and went into commission during the past year, and during the closing six months of 1901 the fresh water shipbuilders commenced the construction of or contracted to build forty-five additional vessels, the contract price of which foots up $10,473,000. All of the tonnage represented in the latter figures is, of course, for delivery during the year 1902, and a large proportion of it will be completed during the first six months of the year.

The really phenomenal prosperity prevalent in Great Lake ship yards in the face of what would naturally be construed as unpropitious circumstances is the more marked by contrast with the comparative dulness in many establishments on the sea coasts, possibly in anticipation of the enactment of ship subsidy legislation. Indeed, so taxed has been the capacity of the inland yards for some months past that in December, 1901, it was impracticable to place in any prominent lake ship yard a contract for a steel ship of moderate size with any expectation of delivery before the autumn of 1902. Perhaps a proper perspective for the situation may be best obtained by a comparison with the conditions existent in previous years, and for this purpose it may be noted that on January 1, 1899, there were only twenty-six vessels of all kinds building on the Great Lakes, their aggregate valuation being $2,974,000, and at the opening of 1900 the thirty-seven vessels on the stocks or on the books of the ship builders, embracing among others the largest vessels ever turned out for inland navigation, represented a total outlay of $8,902,000.

In the above statistics there have been included all vessels of over one hundred tons, whether of wooden or steel construction, but that the metal hull is attaining on the Great Lakes to the same monopoly that it elsewhere enjoys is readily attested. Of the large fleet constructed during the year 1901 only six were of wood, and among the new or uncompleted contracts there can be found commissions for but two wooden vessels. Interesting as is this transition, there is manifest in the current chronicle of lake shipbuilding new tendencies far more revolutionary in influ-

ence than that just cited. Most prominent among these are the abandonment of the policy of constructing vessels of excessive size, and the inclination to dispense with the large tow barges which long constituted a distinctive feature of fresh water shipping.

The gradual growth in length of the lake cargo-carrier reached its culmination in the closing year of the century. Up to that time each successive year had witnessed an expansion in the dimensions of new vessels built for service on the inland seas, and it was freely predicted that this growth would continue along the course already followed in the case of the transatlantic liners. So general was this belief, even among the best informed men in the lake shipping field, that during the old century's final year there were constructed for one interest four vessels, each approximately 500 feet in length, and not less than eight other prominent firms had built a total of seventeen vessels, every one of which was over 400 feet in length, and ten of which were each 450 feet or over. A sudden realization, however, that there are limitations in the conditions of lake navigation imposed by the width and depth of channels, of the early elimination of which there is little prospect, enforced a precipitate halt upon this ambitious vessel growth. The prevalence of this conviction was reflected in the building program for the past year. The largest vessels constructed on the Great Lakes in 1901 had a length of 450 each, and of the entire fleet of sixty-one new vessels only thirteen exceeded 400 feet length, and two of these were designed for salt water service. In the case of the new contracts negotiated during the closing months of the year the tendency is even more marked Of the forty-five vessels only eight exceed 400 feet in length, and the largest vessels are to be but 436 feet over all—what was deemed two years ago merely moderate size.

The passing of the tow barge is not so strongly emphasized, but it is not less significant. In 1901 only two barges or schooners, as they are termed, were built for service on the Great Lakes, and likewise among the contracts placed during the latter part of the year only two commissions were awarded for craft of the barge type. Some minor changes of policy, quite as radical as those cited, have also been manifest in lake vessel building practice within this recent interval.

LAUNCH OF THE STEAMER NORTHTOWN, BUILT AT CHICAGO, ILL.

For one thing there is the transfer of allegiance from the quadruple to the triple expansion engine. In 1900 thirteen of the largest new steamers were fitted with engines of the quadruple expansion type. Of the vessels contracted for or built during the last half of the year 1901 not a single steamer has other than triple expansion engines. In the matter of boilers there has been a similar revision of opinion. In 1900 water tube boilers were fitted in ten of the largest steel steamers constructed at the lake shipyards. Of the entire aggregate of over one hundred vessels built or contracted for during the calendar year 1901 (including, of course, the vessels designed for delivery during 1902) only four have the water tube type of steam generators.

In point of far reaching influence and interest the

first place in the category of vessels constructed on the Great Lakes since the dawn of the century should be accorded to the two large steamers which have been built at Cleveland for C. E. and W. F. Peck, of New York, for these vessels may be said to constitute the fruits of the first serious effort on the part of the ship building interests of the interior to enter the field as competitors of the shipbuilders on the Atlantic and Pacific coasts in the construction of the heavier class of tonnage. At intervals covering a period of many years past lake shipbuilders have turned out steamers of what has been popularly known as the "canal size" —that is, vessels not exceeding 270 feet in length and of approximately 3,000 tons capacity—which could pass without difficulty from the lakes to the sea through the St. Lawrence canals, which permit a maximum draught of 14 feet; but the two large vessels, which will be taken to the sea coast in sections in the spring of 1902, constitute the initial attempt to enter the general competitive field in the construction of ocean-going cargo-carriers of large size.

LAKE STEAMER URANUS.

These large vessels for salt water service are sister craft of the following dimensions: length over all, 443 1-2 feet; length of keel, 430 feet; beam 44 feet; depth, 34 1-2 feet. They are fitted with triple expansion engines with cylinders 27, 42 1-2 and 73 inches in diameter and 48 inches stroke of piston, to which steam is supplied by Scotch boilers working at a pressure of 170 pounds. The capacity of each vessel on a draught of eighteen feet is 7,000 tons, and the cost of each of the steamers approximately $400,000. These vessels have been constructed in the regular manner at Cleveland, but will be cut in two and taken through the Welland and St. Lawrence canals in sections. It is probable that the experiment will be tried of having the stern section containing the machinery tow the bow through the canals. That this disposition on the part of the lake shipbuilders to enter into competition with similar interests on the seaboard is not an ephemeral thing by any means is proven by the fact that ten of the vessels constructed on the lakes in 1901 were for oceanic service, while several of the vessels now on the stocks for delivery in 1902 are designed for the same trade, and by the further circumstance that the American Ship Building Company, the consolidation of the principal lake shipyards, is now considering the advisability of establishing a plant on the lower St. Lawrence in order to facilitate the reconstruction of vessels which have passed through the canals in sections.

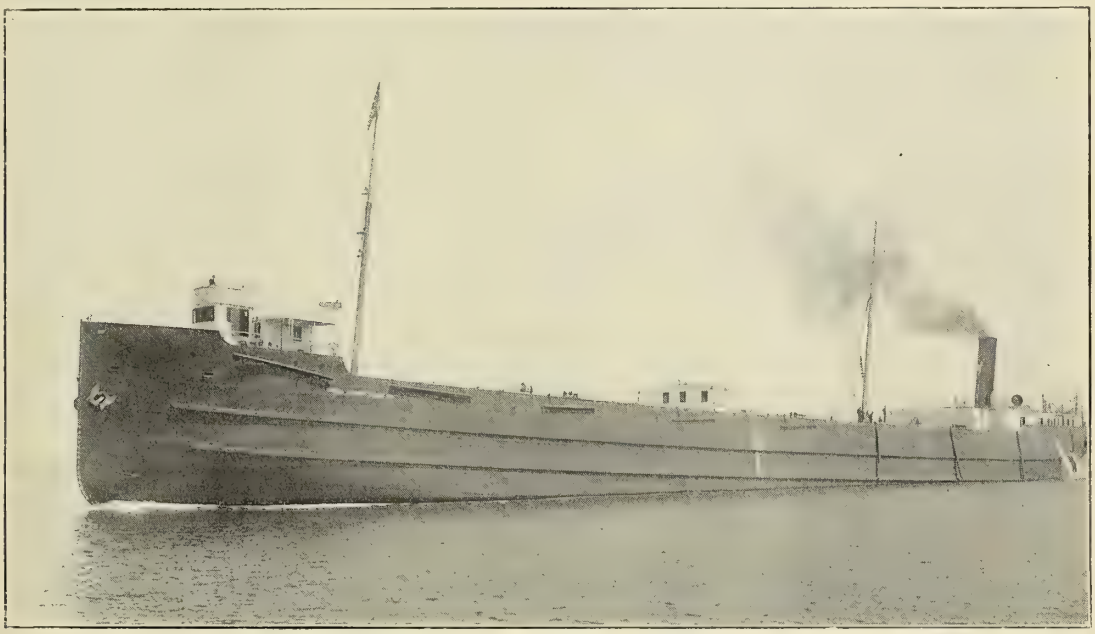
Next in order of importance among the vessels upon which work has been commenced since the opening of the century are the two handsome side-wheel passenger boats for the Detroit and Buffalo Steamship Company, which is to operate, beginning with the season of 1902, between Detroit and Buffalo. The length of the run between these two cities and the desirability of covering the distance in thirteen hours has imposed some rather difficult exactions, and in meeting these there has been evolved a type of speedy passenger boat which it is claimed has no peer in her class.

The vessels known as the *Eastern States* and the *Western States* are each 366 feet in length over all, 350 feet on the water line, 55 feet hull beam, 80 feet beam over all, and 19 1-2 feet molded depth. The walking beam so familiar in most of the large passenger steamers in service on the Great Lakes is absent in these new vessels, the inclined engine having been introduced on the theory that in vessels of this size it is more economical than the beam engine, since it affords greater power and better distributed weight. Steam will be supplied to these triple expansion inclined engines from eight Scotch boilers, and they are designed for 10,000 horse power. The two vessels represent an investment of approximately $1,280,000, and they will be capable of developing a speed of

nearly thirty miles an hour, although ordinary steaming rate when in regular service will not be that high.

In the construction of freighters for cargo-carrying on the Great Lakes the practice heretofore in vogue of contracting for duplicate vessels has been continued to a considerable extent. A thoroughly representative fleet was that constructed at the yards of the American Ship Building Company, at Lorain, Ohio, and Detroit, Mich., for J. C. Gilchrist, of Cleveland, and consisting of the steamers *Mars, Jupiter, Saturn, Neptune, Venus* and *Uranus*. The dimensions of these vessels are 366 feet over all, 346 feet keel, 48 feet beam and 28 feet depth. Propulsive power is furnished by triple expansion engines, to which steam is supplied from Scotch boilers working at a pressure of 170 pounds. The carrying capacity of each vessel is 4,800 tons, and the contract price $215,000.

In view of the oft-repeated rumors of combinations involving a greater or less number of the prominent shipyards on the Atlantic coast, and as an interesting commentary on shipbuilding conditions in general in the lake district, it may not be amiss to glance at the status as to contracts of the American Ship Building Company, which controls seven of the principal steel shipbuilding plants on the inland seas. Of the thirty-seven vessels valued at $8,902,000 building in lake yards at the opening of 1900, twenty-three costing almost $7,000,000 were entered on the books of the consolidation. Of the sixty-one vessels valued at $12,535,000 turned out during 1901, the "trust," so-called, built thirty-six, representing an investment of $9,335,000, and thirty-four of the forty-three contracts for steel vessels placed during the closing months of 1901 for vessels to come out during 1902 went to the consolidation enterprise,

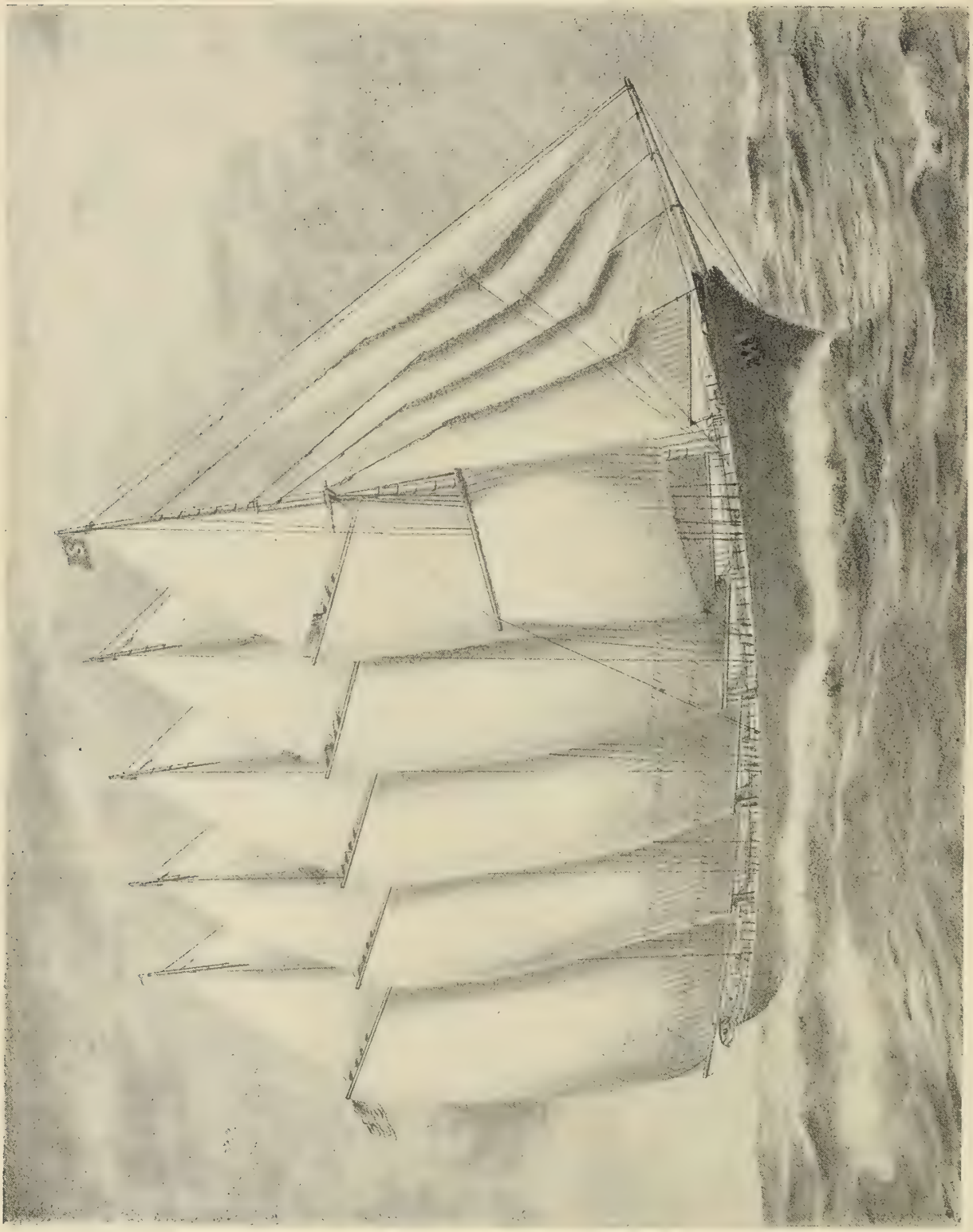


LAKE STEAMER WILLIAM L. BROWN.

The largest cargo-carriers constructed in lake ship yards during 1901 comprised a class of six vessels, the ownership of which was divided between Duluth and Chicago parties. Each vessel is 450 feet in length over all, 430 feet length of keel, 50 feet beam and 28 1-2 feet depth. The carrying capacity is 6,400 tons each. This policy of building a fleet of vessels on a common pattern has been adhered to in the contracts placed during the latter part of 1901 for delivery some months later. Among these vessels to come out early in 1902 there is a class of four vessels each 436 feet in length over all; an equal number of steamers building have a length of 434 feet over all; there are seven 400-foot boats, and ten vessels having the uniform dimensions of 366 feet over all. Included among the vessels turned out during 1901 were two steamers and two barges designed especially for the transportation of copper ore. The steamers are each 336 feet in length, and the barges 312 feet, and all four have a uniform carrying capacity of 4,000 tons.

which thus has on its books $8,730,000 of the new business to be found in the steel shipbuilding plants on the Great Lakes at the dawn of the second year of the new century.

Coal Steamer Mercedes.—A coal steamer for trade between Australia and the west coast of America was recently launched at the Northumberland Shipbuilding Company, Ltd., Howden-on-Tyne, and is equipped with a system for rapidly loading and discharging cargoes of coal and general merchandise. The engines are located aft, like our lake steamers. There are four hatchways 22 feet wide, worked by derrick posts 40 feet high from the deck with eight derricks equipped with the Temperley system of transporters. It is expected that a cargo of 7,000 tons may be discharged from the steamer in sixteen hours. The water ballast amounting to 2,400 tons will bring the ship down to a good draft when without cargo.



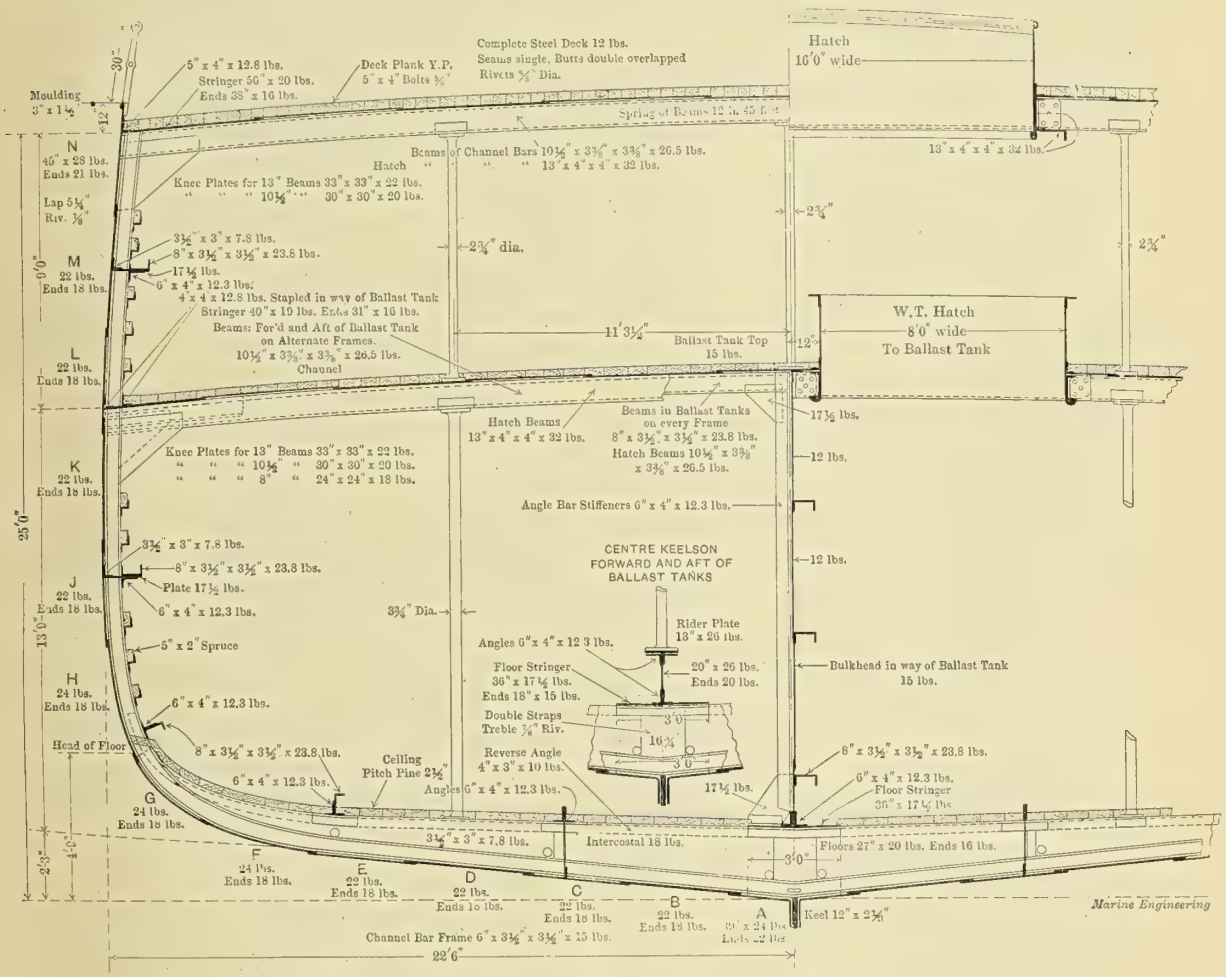
FIVE MASTED STEEL SCHOONER.

MODERN FIVE MASTED SCHOONER.

JAMES A. HARGAN.

There are not a few who really believe that the death knell for the days of sailing vessels has long ago been sounded and that they are now a dream of the past. Let me gently wake all such from their dream, not with a sudden clash of dry statistical figures, but with a few plainly stated facts.

The graceful clipper ships of which we were so proud a few years ago, it is true, have largely disappeared. The ocean tramp and other steamers have been crowding them out of business, but there are still a goodly


Complete Steel Deck 12 lbs.
Seams single, Butts double overlapped
Rivets ⅝" Dia.
Hatch
16'0" wide
5" x 4" x 12.8 lbs.
Stringer 56" x 20 lbs.
Ends 38" x 16 lbs.
Deck Plank Y.P.
5" x 4" Bolts ½"
Moulding
3" x 1½"
Beams of Channel Bars 10½" x 33/8" x 38/8" x 26.5 lbs.
" " 13" x 4" x 4" x 32 lbs.
13" x 4" x 4" x 32 lbs.
Knee Plates for 13" Beams 33" x 33" x 22 lbs.
" " " 10½" " 30" x 30" x 20 lbs.
Lap 5¼"
Riv. ⅞"
2¾" dia.
2¾"
3½" x 3" x 7.8 lbs.
8" x 3½" x 3½" x 23.8 lbs.
17½ lbs.
6" x 4" x 12.3 lbs.
4" x 4" x 12.8 lbs. Stapled in way of Ballast Tank
Stringer 40" x 19 lbs. Ends 31" x 16 lbs.
Beams: For'd and Aft of Ballast Tank
on Alternate Frames.
10½" x 33/8" x 33/8" x 26.5 lbs.
Channel
11'3¼"
Ballast Tank Top
15 lbs.
W.T. Hatch
8'0" wide
To Ballast Tank
Hatch Beams
13" x 4" x 4" x 32 lbs.
Beams in Ballast Tanks
on every Frame
8" x 3½" x 3½" x 23.8 lbs.
Hatch Beams 10½" x 3⅜"
x 3⅜" x 26.5 lbs.
Knee Plates for 13" Beams 33" x 33" x 22 lbs.
" " " 10½" " 30" x 30" x 20 lbs.
" " " 8" " 24" x 24" x 18 lbs.
Angle Bar Stiffeners 6" x 4" x 12.3 lbs.
CENTRE KEELSON
FORWARD AND AFT OF
BALLAST TANKS
Rider Plate
13" x 26 lbs.
20" x 26 lbs.
Ends 20 lbs.
Angles 6" x 4" x 12 3 lbs.
Floor Stringer
36" x 17½ lbs.
Ends 18" x 15 lbs.
Double Straps
Treble ⅞" Riv.
Reverse Angle
4" x 3" x 10 lbs.
Bulkhead in way of Ballast Tank
15 lbs.
Ceiling
Pitch Pine 2½"
Angles 6" x 4" x 12.3 lbs.
Floor Stringer
36" x 17½ lbs
Intercostal 18 lbs.
Floors 27" x 20 lbs. Ends 16 lbs.
Keel 12" x 2⅜"
Channel Bar Frame 6" x 3½" x 3½" x 15 lbs.
22'6"
Marine Engineering

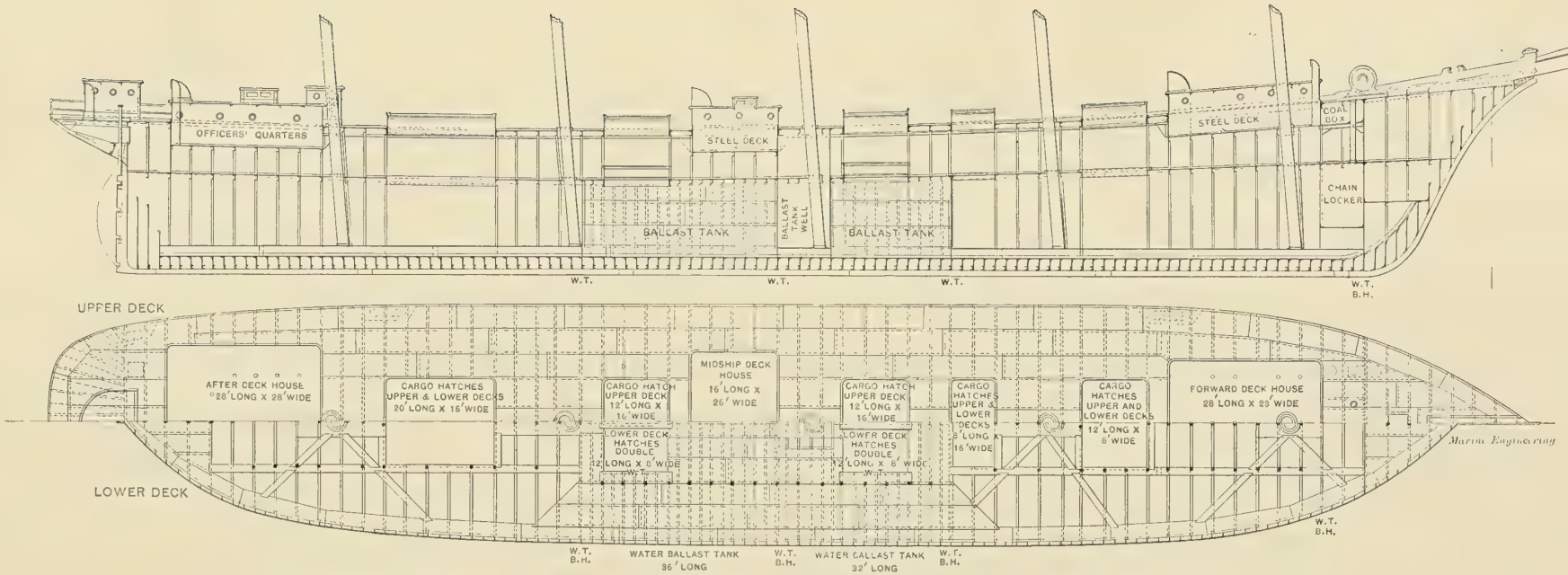
MIDSHIP SECTION OF FIVE MASTED SCHOONER.

number of fine sailing vessels of this order on the ocean, and being built even in this the twentieth century, many of them much larger and heavier than of old, and are found by their owners to be still a good paying investment. Especially can this be said of the schooner type of coasting trader when built and equipped in an up-to-date manner; but even in this class the small fry are being rapidly run out by the big ones, and all along our eastern and southern coasts we find a brisk movement in the building of these large schooners. But, strange to say, the large majority of these vessels, in point of number, is being built of wood. This, of course, is readily explained, since the first cost of a wood vessel is materially less than a steel one. The latter has of course many advantages in point of economy, durability, etc., over the former, which, however, it is not the writer's purpose to discuss in this article. Suffice it to say that as the size of these vessels increases the necessity of using steel construction becomes more urgent.

The pioneer of the steel sailing ship builders of our country is the well-known firm of Arthur Sewall and Co., of Bath, Me., who are not only extensive builders, but own and operate a large fleet of sailing vessels which trade to all parts of the world. A few words about this firm will certainly interest all American readers who are interested in our shipbuilding and maritime progress.

The firm of Arthur Sewall and Company has been in existence and constant working order since 1823, and from that time to the present they have kept up an unbroken record in the construction of sailing vessels, over one hundred of which have been built.

Their first vessel of wood was the brig *Diana*, of 314 tons, built in 1823. This was followed by others of gradually increasing size, and in 1841 they built the



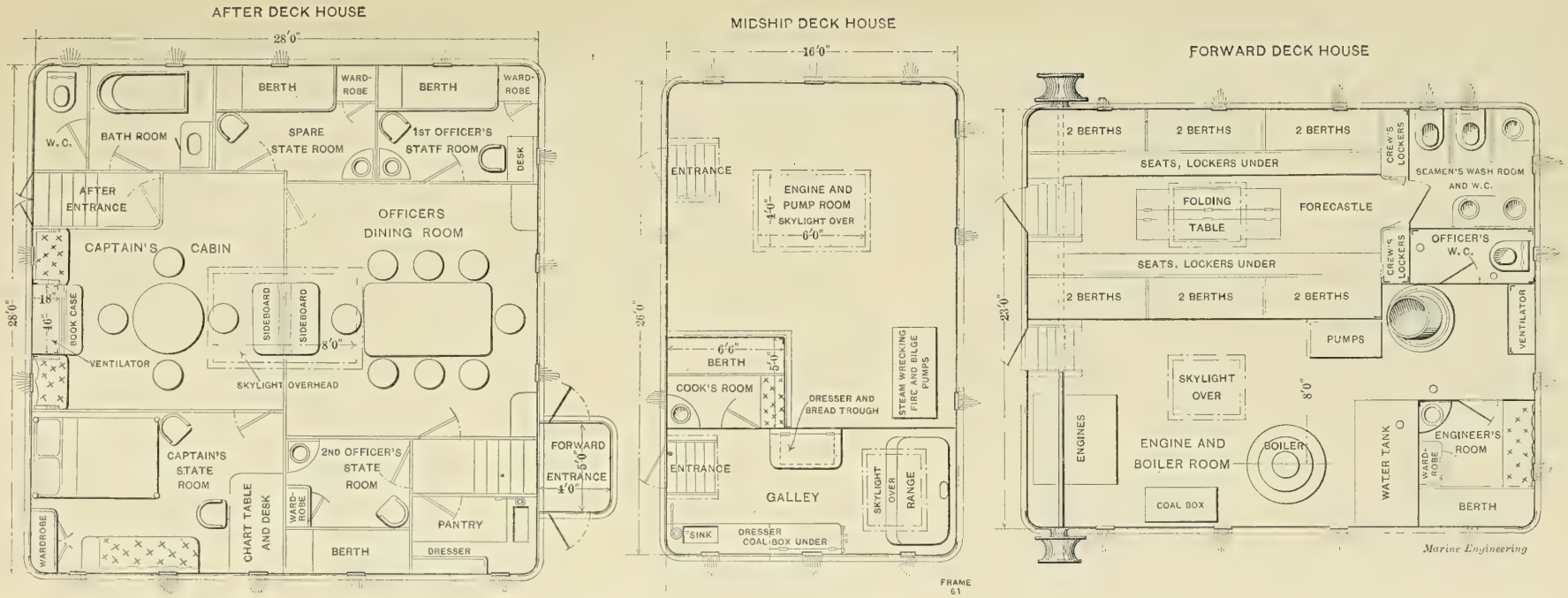
LONGITUDINAL SECTION AND DECK PLANS OF FIVE MASTED SCHOONER BUILDING BY ARTHUR SEWALL AND COMPANY.

ship *Rappahannock*, of over 1,000 tons register, at this time the largest American sailing ship afloat. Still the demand was for larger ships. In 1893 the firm became convinced of the necessity of building steel ships. Consequently, in order to keep pace with modern requirements and demands, they entered the field as steel ship builders, and during the year 1893 built and launched the first steel sailing ship constructed in the United States, the *Dirigo*, of 3,000 tons. Since this time they have built many fine specimens of sailing ships, barks, etc., that are famous as good sailers and carriers the world over. Among these may be mentioned the ships *Erskine M. Phelps, Arthur Sewall, Edward Sewall, Wm. P. Frye, Acme*, the bark *Kaiulani*, and many others.

The yard is splendidly located on the banks of the Kennebec River, with deep water right up to their wharves. It is fully equipped with the best modern appliances and tools for the business, and this firm is perhaps the only one in the country making an exclusive specialty of steel sailing vessels.

The firm is now building several large steel sailing vessels, among the number being the ship *Atlas*, of about 3,500 tons, for the Standard Oil Co. This vessel is nearing completion and was recently launched. Recent orders have been placed with the Carnegie Steel Company for the material to build a mammoth steel double-decked five-masted schooner as an addition to their own large fleet of vessels, plans of which accompany this article. This craft will possess many novel features in construction, general arrangement and detail of fitting, all conducive to the safety, speed and usefulness of the vessel, as well as to great economy in handling. Among her principal features will be an arrangement for carrying 1,242 tons of water ballast in bulk without having recourse to the double bottom system usually adopted by steamers for this purpose. To attain the results desired a series of ballast tanks has been designed, extending in height to the lower deck. These tanks are each fitted with large water-tight cargo hatches, so that when in ballast the hatches can be closed absolutely water-tight, or, when in freight, can be used as ordinary cargo hatches, making the ballast tanks available as holds for cargo of any description, thus giving the full freight capacity of the vessel's hold, which could not be had with a double bottom, and materially diminishing the cost of construction and subsequent care.

At the same time this makes a much stronger and safer vessel by the increased water-tight subdivision formed by the additional bulkheads, deck plating and beams. The great advantages and economy accruing from the use of water for ballast needs no more comment than that it can be safely and quickly loaded or discharged, and at no further cost than the mere nomi-



PLANS OF STEEL DECK HOUSES ON FIVE MASTED SCHOONER.

nal one of running the pumps; and the vessel will be fully equipped with ample steam pump capacity for this purpose. The pumping station will be located in the midship deck house, the pumps being connected directly to the tanks through the pump well adjoining, and extending from the keel to the upper deck. This pump well will be entered from the deck house through a water-tight manhole, thus affording access to all the pipes, valves, etc., at all times, whether the vessel is filled with cargo or the tanks with water ballast, all valves and pipes from the pumps to the tanks and from the sea to the pumps being located in this pump well. Steam pump connection is also provided for each of the vessel's holds or bilges, in addition to large hand pumps for this purpose, which, in their turn, may be driven by steam power from the hoisting engines located in the midship deck house. These hoisting engines are threefold in purpose; they are arranged for handling cargo, for handling the vessel's sails, etc., and for working the hand pumps by messenger chains.

The ship's galley and cook's room is also located in the midship deck house, and the floor of the galley, engine and pump room will be covered with cement and handsomely tiled.

The main hoisting engines will be located in the forward deck house, and these engines will also have a threefold purpose: for handling cargo, for handling the vessel's sails, etc., and for handling the vessel's anchor chain and warps through the large specially designed windlass and capstan, which may also be operated by hand.

The two main bower anchors will be of the latest improved stockless type, thus being carried in the hawse pipes constantly ready for use, and abolishing the necessity of fitting anchor davits or catheads, and materially simplifying the labor of handling and stowing the anchors. The boiler which supplies steam for the engines, pumps, heaters, etc., is located in the forward deck house, and is of the vertical cylindrical type.

Should the vessel be placed in foreign trade requiring long voyages, a distilling and evaporating plant will be added. The floor of the forward engine and boiler room will be covered with cement and handsomely tiled. The engineer will have a state room in the forward deck house. The seaman's forecastle, with accommodations for twelve men, the officers' water closet and seamen's head and wash room are all located in the forward deck house, special care and at-

tention being given to the lighting and ventilating of each room, and all plumbing will be of the latest improved sanitary type for ship's use, thereby insuring the health and comfort of the vessel's crew.

The after deck house is arranged for the accommodation of the captain and officers, with spare state-room for the owners or passengers. A special cabin, state-room and bathroom is provided for the captain, a special state-room for each officer, with a dining room and pantry common to all. These quarters will be handsomely finished in hard wood, with all modern conveniences and appliances for the health and comfort of the occupants.

Abaft of the after deck house will be located the chart or wheel house, in which will be located the steering gear, which will be of the latest improved screw gear hand-power type. This house will be built of steel, with circular after end and square front, the fore end, having heavy plate glass windows, and circular air ports on the sides.

The forward, midship and after deck houses will all be built of steel on the trunk deck pattern, extending only about 4 feet above the upper deck, the sides continuing down to the floor beams, forming strong fore and aft girders, connecting with continuous fore and aft girders under the upper deck on each side of the cargo hatches and thoroughly supported with beam stanchions, thus strengthening the upper deck for a heavy deck load when necessary. The beams forming the floor of the forward and after deck house extend from side to side of ship, thereby adding greatly to the vessel's strength and resistance to panting. The five enormous masts and spike bowsprit will be all of steel.

The vessel will be built to the highest class A1, twenty years under the America Bureau of Shipping, and will equal in scantling and construction the highest classification given by Lloyds Rules, and when completed will undoubtedly be one of the largest, handsomest, best appointed and most economical vessels of her type on our extensive seaboard. She will be equally serviceable for coasting or foreign trade, and will be a marked advance over any of her present compeers. The designs were prepared by the writer.

The principal dimensions of the vessel are as follows:

Length over all	274 ft. 9 in.
Length registered	251 " "
Beam	45
Depth molded	25 " 0 "
Load draft (from bottom of keel)	21 " 0 "
Corresponding displacement	4530 tons
Deadweight carrying capacity	3132 "
Area of immersed midship section	828 sq. ft.
Coefficient of immersed midship section	.92
Block coefficient	.728
Prismatic coefficient	.792
Tons per inch of immersion at load draft	22.35
Cargo Capacity	176000 cu. ft.
Capacity of water ballast tanks	1242 tons
Sail area including square fore sail	25920 sq. ft.

Inspector of Boilers.—The United States Civil Service Commission announces that on April 22-23 an examination will be held in leading cities throughout the United States for the position of Inspector of Boilers in the Steamboat Inspection Service at Dubuque, Iowa, and other similar vacancies as they occur, at a salary of $1,500 a year. Persons desiring to compete should apply to the commission, Washington, D. C., before April 12th for rules covering the examination.

The Wreck of the Steamer Grecian.

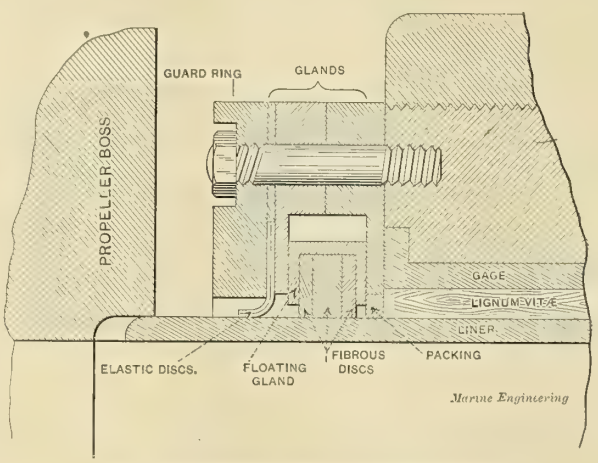
This winter's storms have caused the wreck of many a ship in the north Atlantic service, and the accompanying views illustrate the sad fate that may await a ship that once leaves her native element. The Allen line freight steamer *Grecian*, bound for Halifax, N. S., went ashore on February 9th near the entrance to the harbor of Halifax during a snow squall. The vessel struck on the rocks as shown, and although attempts were made to float her off they were unsuccessful before a severe storm on the 17th drove her still further on shore and broke her in two, as shown in the lower engraving, which was taken the day after. The force of the waves on this rock-bound coast is well shown by the high bank of spray at the left, which is a sea breaking over the bow. The upper illustration was taken a few days later and shows the further damage to the vessel. The hull amidships is practically washed away, opening up the engine and boiler rooms. One section of the plating has been washed up on the rocks.

The *Grecian* was built at Sunderland, England, in 1879, and is 360 feet long, 40 feet 2 inches beam, 31 feet deep, and of 3,481 gross tons. Captain Harrison, who commanded the ship, testified at the inquiry into the loss of the vessel that there was a slight deviation of the compass. If he had not taken a pilot on board he would not have attempted to come into the harbor at that time.

Lubrication for Tail Shafts.

A device for preventing the corrosion of tail shafts, by filling the stern tube with oil, has been brought forward by Messrs. Benjamin R. Vickers and Sons, of Leeds, England.

In the system illustrated the oil is supplied auto-



OIL RETAINING RINGS AT STERN PORT.

matically, and a continuous circulation is maintained without requiring the attention of the engineers.

Oil flows into the stern tube from a reservoir placed on the deck, and there becomes slightly heated by friction. Then it passes back through the up-flow pipe and is replaced by the cooler liquid. Testing cocks and pipes are provided and the apparatus is so arranged that the engineer can readily see if it is working properly. The oil used must be free from acids, otherwise

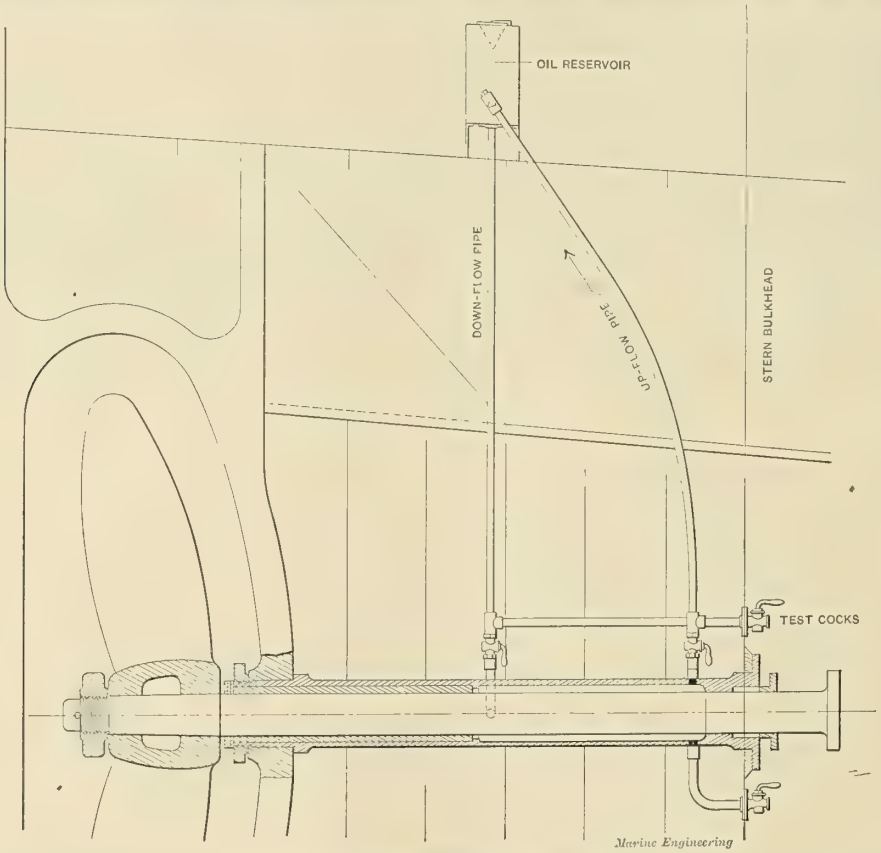
WRECK OF THE GRECIAN. VIEW TAKEN AFTER SECOND STORM.

THE FREIGHT STEAMER GRECIAN WRECKED NEAR THE HARBOR OF HALIFAX, N. S. ON FEBRUARY 9TH. VIEW TAKEN AFTER FIRST STORM.

Photo. by Gauvin & Gentzel, Halifax, N, S,

corrosion will set in almost as serious as that resulting from the salt water. For further clearing the oil, a filter is placed on top of the reservoir.

A patented oil-retaining appliance is attached to the stern tube entirely independent of the propeller, consisting of specially prepared fibrous and other disk packing rings fitted round the shaft and protected from the sea. The fibrous material expands when in contact with the oil, making a tight joint without causing friction. The detail drawing illustrates the construction. They are fitted in a floating sheath, which rises and falls with the shaft and which works inside a metal



SYSTEM OF LUBRICATING TAIL SHAFT.

gland. Outside these and under the guard ring are two elastic disks, the inner edges of which lie along the shaft between it and the guard ring, so that in case the stern bush should become worn these would be pressed close round the shaft by the pressure of the water and will assist in keeping the oil in the stern tube and the water and sand out.

This system can be readily applied to old ships and no alterations are required to the stern tube or bush. The rings are made in halves and can be fitted without removing the propeller. For new ships the patentees recommend a linerless shaft, running in a cast iron or white metal bush, with suitable grooves for the oil to flow freely through both the stern bushes. It is claimed for this arrangement that it will be both cheaper and give more satisfaction than the present forms.

In April, 1901, the twin-screw channel steamer *Ibex* was fitted with this patent system. The vessel steams 18 knots, and has 11-inch shafting running 145 revolutions per minute. Much trouble had been previously experienced from sand getting into the stern tube, but since the above date sand has been kept out, and very little, if any, wear in the stern bearing has been noticeable.

Wreck of the Steamer Wilster.

During the stormy night of February 28th, the tramp steamer *Wilster*, Capt. G. O. Tookes, from Malta to Boston, went into the breakers on Cape Ann, Mass., and stranded hard and fast on a ledge in a most dangerous position. The accompanying illustrations were taken after the storm had gone down. The vessel first struck on Salt Island but worked herself off, and while Capt. Tookes was feeling his way along the shore the steamer again struck on the beach. Signals which the vessel sent up were seen by people along the shore, and lifesavers soon came to the rescue and took off the members of the crew in the breeches buoy. The ship was loaded with sugar, and her cargo has been discharged and efforts are being made to float her.

Several attempts were made by tugs and the wrecking company to pull the stranded steamer off. Most of her cargo of sugar was lightered from the ship and towed to port, but then the combined pull of all the tugs was not successful in floating the ship. On account of excessive storms the vessel was driven further on the beach and deeply imbedded in the sand, and at the time of going to press it is doubtful if the ship will be gotten off.

BOW VIEW OF THE STRANDED STEAMER WILSTER.

STEAMER WILSTER STRANDED ON LONG BEACH, ROCKPORT, MASS.

Photo. by R. W. Phelps, Gloucester, Mass.

LIGHT DRAFT HYDRAULIC DREDGE.

Inside of the low coast line of the Gulf of Mexico there stretches a series of shallow lakes and bayous, the utilization of which will form part of a system of improved inland navigation. This scheme, which has been projected by Captain C. S. Riché, Corps of Engineers, Galveston, embraces the dredging of existing bodies of water, and the cutting of connecting canals forming eventually a water way for light draft steamers, from the Mississippi river to the Rio Grande, and is intended to serve as a feeder to the ocean commerce of the port of Galveston. For the prosecution of this undertaking a light draft dredge was required, and the work of designing and preparing the necessary drawings and specifications was entrusted to Captain Mason M. Patrick, Secretary of the Mississippi River Commission, St. Louis, and accomplished by Mr. Thomas Middleton, the consulting engineer of that department.

The special requirements controlling the design were: that the dredge should not exceed 4 feet draft; that the hull should be of wood in order to reduce first cost and facilitate repairs in the field; that it should be self-propelling; that it should be capable of dredging stiff clay as well as sand, gravel and shells; that it should discharge on either side and at an elevation for the making of banks, also by means of a floating pipe astern; that the dredge should be provided with means for removing snags embedded in the cuts; should be adaptable for service in salt water; should be fitted with tools suitable for making repairs in the field; should have ample cabin accommodation for crew, and finally the cost was not to exceed $60,000. In order to fulfill this last requirement and at the same time obtain a dredge having a pumping outfit of fair capacity, it was decided to make separate contracts for the various units which were indispensable; to erect the machinery by hand labor; and to purchase other desirable accessories and a more complete outfit later on, when further appropriations will be available. This procedure was very satisfactory and resulted in making contracts at the following figures:

Hull	$10,930.00
Main Pump and Engines	8,338.00
Propelling Engines, shafts and propellers installed	5,025.00
Boiler and Fittings	3,945.00
Surface Condenser with Air and Circulating Pumps	2,498.00
Suction frame, fittings for discharge pipes, shear legs, etc., and steam spud lift	5,293.50
Plate steel pipes in connection with main pump, including spudwell and ash chute	800.00
One jet pump and two feed pumps	1,600.00
Distilling plant	1,090.00
Refrigerating plant	1,295.00
Electric light plant, exclusive of wiring	1,050.00
Total	$41,864.50

Thus allowing about $18,000 for building cabin, installing machinery and purchasing minor machinery outfit, and general furnishing.

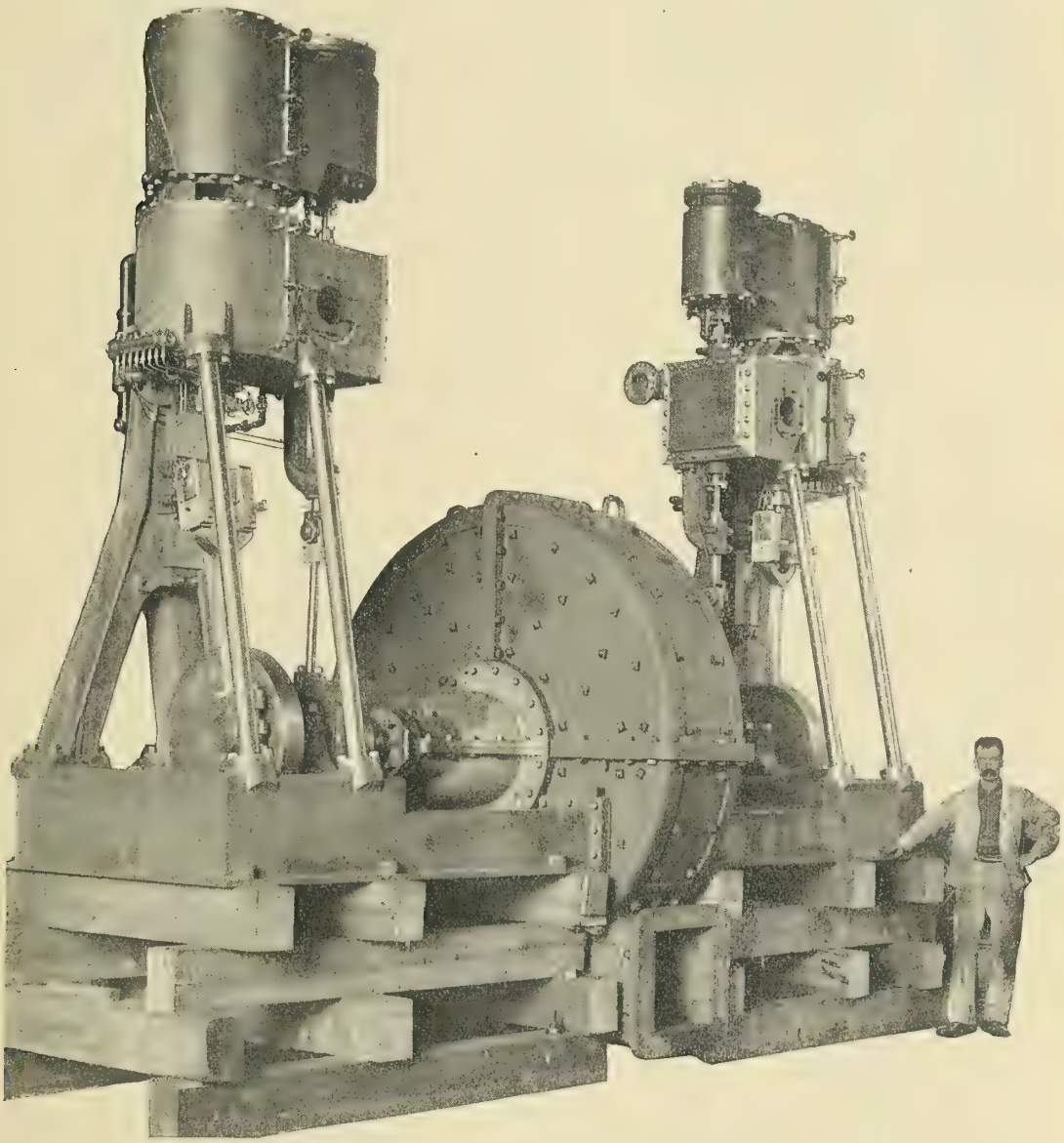
DETAILED DESCRIPTION OF HULL.

The hull is 132 feet long; with a projecting fan-tail of 6 feet; 32 feet wide and 7 1-2 feet deep, molded dimensions; the deck having a crown of 8 inches makes the total depth at center line 8 feet 8 inches. A recess is formed in the bow 10 feet wide and 22 feet long, in which the suction frame is placed, and all the machinery, except the jet pump and boilers is placed in a pit 18 feet wide and 50 feet long. The hull is built of long leaf yellow pine throughout, with the exception of knees, which are of mulberry or live oak, and is sheathed to a height of 4 feet 6 inches from the bottom with 1 inch boards thoroughly creosoted, over a layer of tarred sheathing felt. The dimensions of the principal scantlings are as follows: Floor timbers sided 5 inches molded 8 inches in the straight body, diminishing to 6 inches at the rakes; frames sided 5 inches molded 8 inches at butt and 5 inches at head, secured to floor timbers by futtocks and side plates; frames at side of suction well and engine pit sided 5 inches, molded 6 inches; deck beams sided 6 inches, molded 13 inches at center and 5 inches at ends. Special deck beams sided 13 inches and 11 inches are placed at ends of well and engine pit, etc. The clamps are sided 4 inches, molded 10 inches, shelf pieces sided 4 inches, moulded 8 inches; and the bilge clamps are sided 5 inches molded 22 inches at the straight body diminishing to 12 inches at the rakes. The bilge clamps land on the futtocks and are bolted through the knuckles at every frame. The two middle keelsons running aft from suction well are 6 inches wide and 10 inches deep, and the two side keelsons are 8 inches wide and 10 inches deep, all diminishing to 5 inches deep at the rakes. The sides of engine pit are formed by riders 18 inches deep on top of side keelsons and 3 inches planking up to deck. The floor beams for engine pit are sided 4 inches molded 8 inches and spaced at 18 inches centers. All planking is 3 inches in thickness, strakes below water line 10 inches or 12 inches wide, above water 6 inches wide, and deck 5 inches wide. The hull is divided into four compartments by three transverse water-tight bulkheads, framed and planked same as hull. Reference to the diagrams will show clearly further details of the construction of the hull.

DREDGING MACHINERY.

The main pump is of the centrifugal type now so generally used for dredging sand and mud, but embodying such improvements as have been dictated by experience in the large dredging operations carried on annually for the maintenance of navigation on the Mississippi river, during the low water season. The runner is 72 inches in diameter and is of the enclosed type, consisting of a spider with five blades, to which are riveted side plates of steel, 1-2 inch thick. The blades are made concave on the driving side in order to prevent guttering at the points of contact with the side plates, due to the attrition of the sand in flowing through the runner. The pump casing is made with paralleled sides to facilitate the use of renewable liners; and is divided into parts to admit of easy handling for inspection and repairs. The inside of casing and the runner are machine finished. Steel

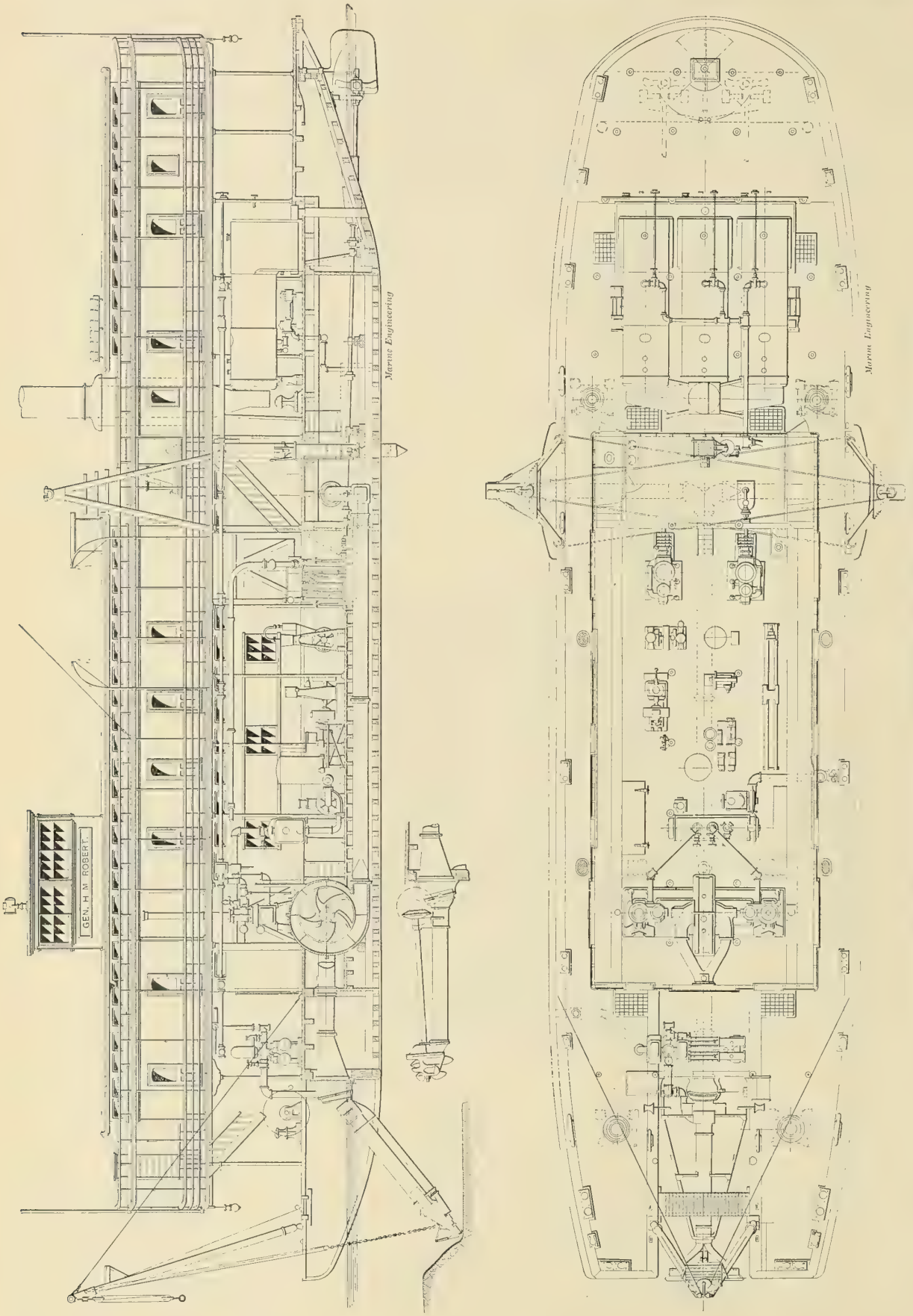
plate liners 5-8 inch in thickness are used on each side of the runner, cast iron liners 3-4 inch in thickness on the sides of casing beyond the runner, and steel plates 1-2 inch thick on the circumference. The throatliners are of cast iron and are held in place by the bolting of suction elbows to the casing. The suction pipe is divided as it approaches the pump and enters on both sides, thus placing the runner in



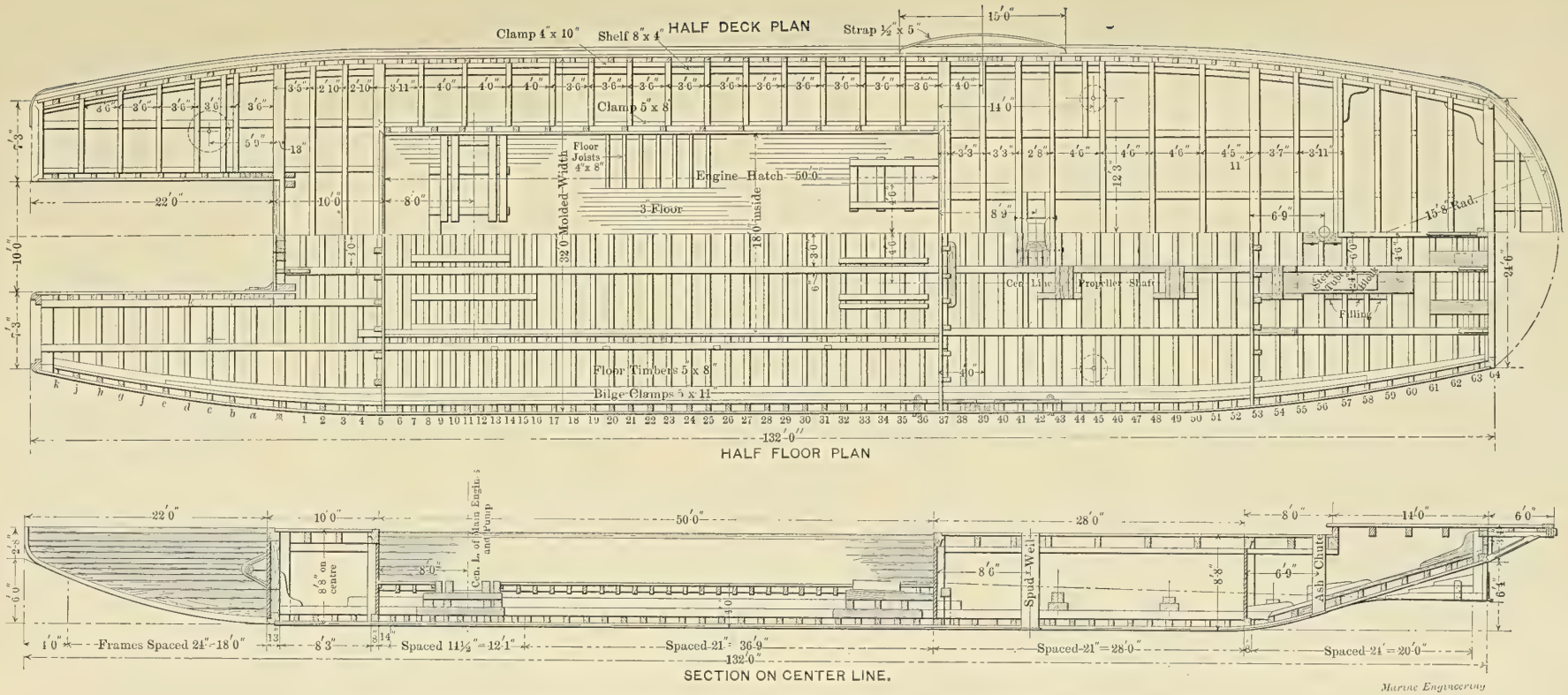
TRIPLE EXPANSION ENGINE DRIVING CENTRIFUGAL DREDGING PUMP

equilibrium, and dispensing with the thrust bearing which is necessary in single suction pumps. The pump is driven by a vertical triple expansion four cylinder engine arranged in two units, the shafts being connected to the pump shaft by flanged couplings. The high pressure cylinder is 14 inches in diameter; the intermediate is 21 inches and the two low pressure cylinders are each 23 1-2 inches diameter, with a common stroke of 18 inches. The engines will run at 150 revolutions per minute giving the pump a peripheral velocity of 47 feet per second, which will maintain a head of 34 1-2 feet with a pump efficiency of 60 per cent. With reduced efficiency as the pump wears the engine revolutions can be increased to maintain the desired head. The general arrangement of engines and pump is shown in the engraving below.

The dredge will at first be fitted for sand digging only; the machinery and cutter head for handling stiff clay and other compacted material will be added later on. The suction frame for sand digging is shown on page 180, and consists mainly of a 20-inch pipe attached to a channel bar frame and working on a ball and socket joint and a pair of trunnions attached to the hull of the dredge. The mouthpiece is 9 1-2 feet wide and is fitted with screen-bars to prevent large drift from passing into and choking



ELEVATION AND PLAN OF MAIN DECK OF HYDRAULIC LIGHT DRAFT DREDGE, GEN. H. M. ROBERT.
Small view to the left is the Cutter Head to be used when Dredging in Clay.



DECK PLANS AND SECTIONAL ELEVATION ON CENTER LINE OF LIGHT DRAFT HYDRAULIC DREDGE.

the pipe. This mouthpiece is fitted with a water jet agitator for loosening the sand to be removed, and consists of a header from which seven pipes lead radially to the underside of the mouth, the pipes being reduced at the ends to form 5-8 inch nozzles. The water is supplied to jets at pressures up to 100 pounds per square inch by a duplex compound steam pump, with cylinders 8 inches and 12 inches diameter, plungers 10 inches diameter and a stroke of 12 inches. This pump can also be used for fire purposes, and is arranged to admit high pressure steam into the low pressure cylinders when the higher pressures of water are required.

The discharge from the main pump is taken underneath the floor of the engine room by a 20 inch pipe to a Y branch fitted with a swing valve by means of which the dredged material can be discharged on either side of the dredge as desired. The outboard delivery pipes are carried by a ball and socket joint at the side of the dredge and are suspended from shear legs by which means they can be raised or lowered as occasion may require for depositing the spoil on shore for bank building, or discharging into sloughs alongside the dredged channels. Where the spoil has to be dumped at any considerable distance, a pontoon pipe line will be used.

When working in soft, free flowing material the dredge will be fed into the cut by head cables anchored at convenient distances and hauled in by the steam capstans on forward deck, shown on the general plan. These capstans are driven by pairs of horizontal engines with 6-inch cylinders and 8-inch stroke. A pair of smaller capstans with 5-inch by 7-inch engines are placed abaft the engine house for handling the discharge pipes and general purposes. When dredging in hard material, which requires the cutter head to disintegrate it, the feeding will be done by swinging from the spud anchor located at the after end of engine house. Head lines will be used for the advance

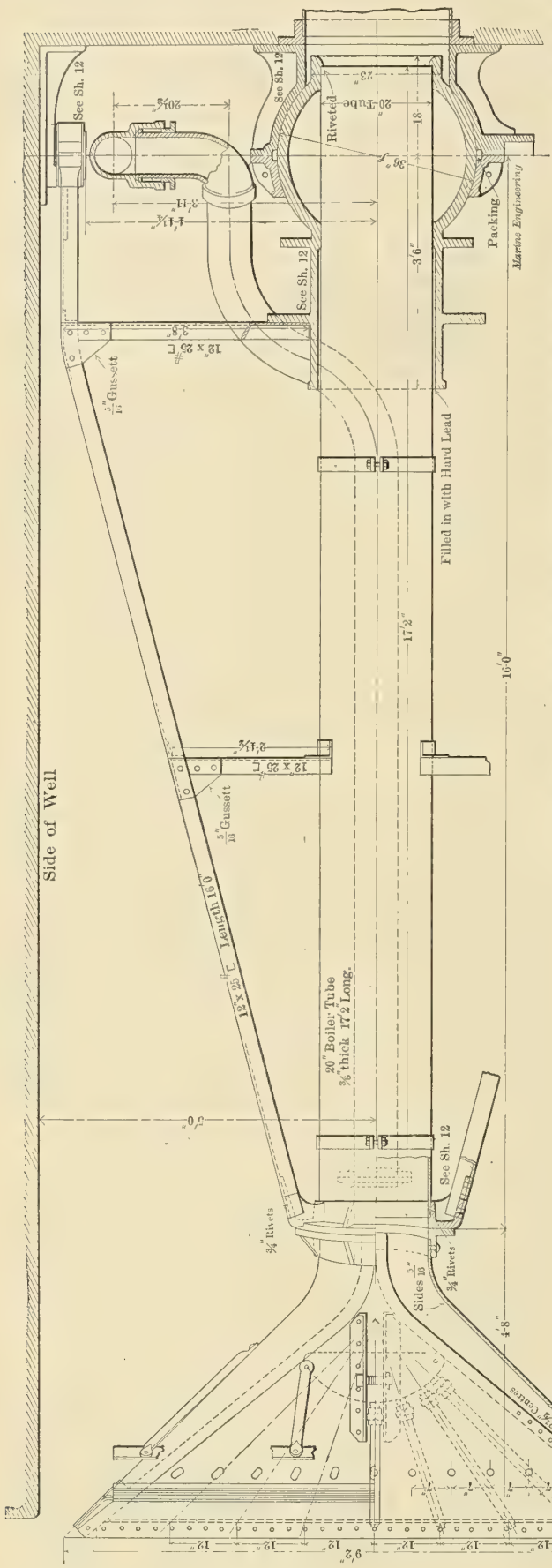
and breast lines for the swing. The spud anchor is raised by means of a steam cylinder 15 inches diameter and 6 feet stroke, and is dropped by a tripping dog, which engages in a rack on the face of the spud. The bow shears are made from selected sticks of yellow pine 10 inches square and are intended for use in clearing the channel from snags as well as for handling the suction heads.

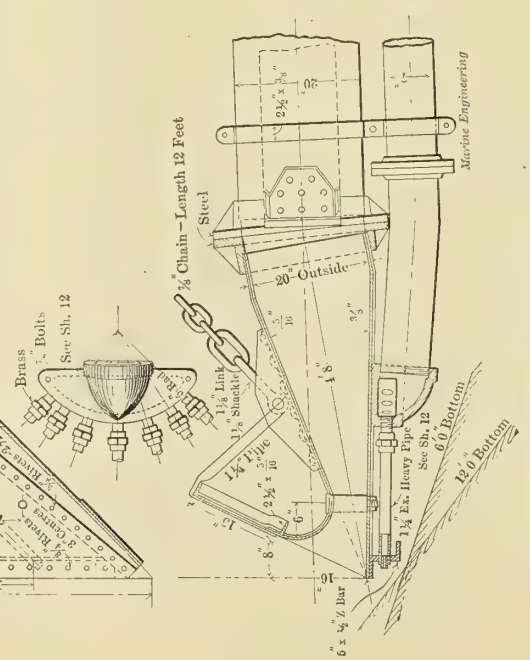
PROPELLING MACHINERY.

The dredge is propelled by twin screws 4 feet 9 inches diameter and 5 feet 9 inches pitch, fitted with removable blades. Owing to the shallow draft of the boat the propellers project 12 inches above the water line and are covered with hoods, which will give the same effect as though they were entirely submerged. The engines are compound, with high pressure cylinders 12 inches, low pressure cylinders 22 inches in diameter and 12 inches stroke, and are located at the after end of the engine room. This gives unusually long intermediate shafts, but what little disadvantage there may be in this respect is amply compensated for by the greater convenience in having the machinery concentrated in one engine room and in charge of one engineer. The surface condenser is of the ordinary marine type containing about 1,400 square feet of cooling surface and furnished with circulating water by a 6-inch centrifugal pump driven by a 6-inch by 6-inch vertical engine. The air pump is a 6-inch by 10-inch by 8-inch of the vertical suction valveless type.

STEAM PLANT.

Steam is furnished by three boilers of the locomotive type, but having combustion chambers extending between the furnace and the tubes. The boilers are 5 feet diameter of barrel 7 feet 3 inches height in front and 18 feet 6 inches length. The furnaces are 5 feet long, combustion chambers 3 feet 3 inches long and



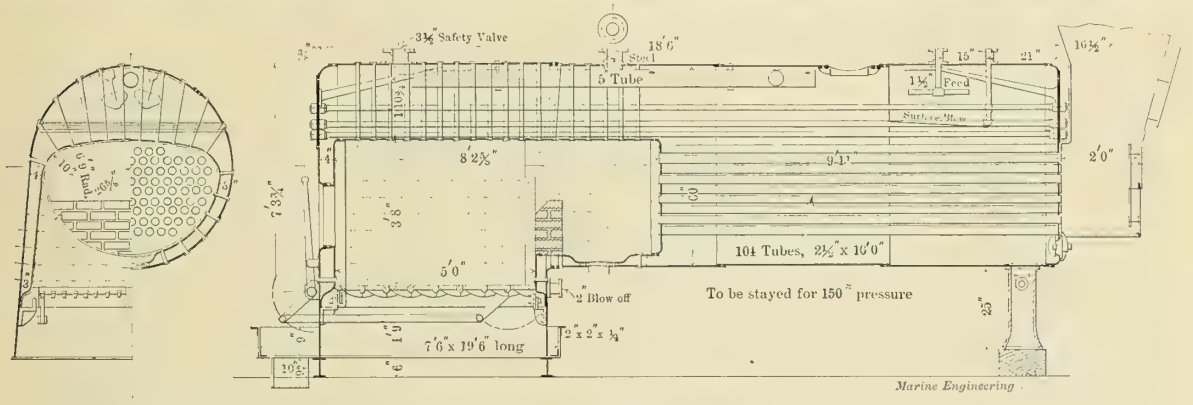


SUCTION FRAME FOR SAND DIGGING.

each boiler contains 104 tubes 2 1-2 inches diameter and 10 feet long. The total grate surface is 75 square feet and the total heating surface 2,400 square feet. The boilers are provided with shaking grates and are adapted for burning either coal or wood, but since the development of the Texas oil fields has provided a cheaper fuel near at hand, it is probable that oil will be used in the near future. One chimney only is used for the three boilers, but it is divided into three flues by plates extending the entire length, giving the effect of a separate chimney for each boiler.

In addition to the dredging and propelling machinery the boat will be fitted out very completely with electric lighting, evaporating and refrigerating plants, machine and blacksmith shops and machine tools. The lighting plant consists of an 11 K. W. multi-polar generator driven by a 7-inch by 7-inch vertical engine at 350 revolutions per minute, and will operate a searchlight of 4,000 C. P., two arc lights of 2,000 C. P. and about 60 incandescent lights distributed throughout the cabins, engine room, main deck and hold. The evaporator is capable of supplying 2,000 gallons of fresh water in 24 hours and will also furnish enough filtered water for all domestic purposes. The refrigerating plant is of the direct expansion system, and will cool a storage room of 500 cubic feet capacity and also sufficient drinking water for the crew. The ammonia compressor is 4 inches diameter and 5 inches stroke driven by a 6-inch by 5-inch vertical engine at 180 revolutions per minute.

The cabins are very commodious and besides furnishing accommodation for a crew of 30 men, will contain a large office, a spare state room for inspecting officers, bath rooms for officers and crew, cold storage room and large kitchen and mess rooms,



BOILER FOR LIGHT DRAFT DREDGE.

Torpedo Boat Builders.—The builders of torpedo boats and destroyers have appealed to the Secretary of the Navy for an increased payment over the contract price for these vessels, owing to the cost being so much greater than anticipated. The builders state that they have lost much money on contracts, and the total amount asked for is over $200,000. The Secretary has decided that he has no authority to pay this amount.

GERMAN EMPEROR'S YACHT METEOR III.

No launch within recent years has occasioned such universal interest as that of Emperor William's schooner yacht *Meteor*, launched from the yard of the Townsend-Downey Shipbuilding Company, Shooters Island, N. Y., on February 25th. This affair took on international importance because of the parties who participated in the ceremony. Miss Alice Roosevelt, daughter of the President of the United States, broke the bottle of champagne on the vessel's bow, and, in the name of His Majesty the Emperor of Germany, christened her *Meteor III.* The distinguished guests present included Prince Henry of Prussia, the Emperor's brother, President Roosevelt and many other distinguished men. The launching of this yacht was unique in many respects and was successful in every way.

The ways were laid with an inclination of 1 1-16 inches to the foot. The ground ways were 14 by 14 inches, and the sliding ways were 8 by 14 inches. The ways were laid with a distance of 13 feet 0 inches between centers. The yacht was started by a falling weight on each side knocking a dog shore out of position. The view on page 183 shows the general arrangement of the dog shores, weights, trips and trip line holding them. The trip line ran from the trip on one side of the yacht across the chopping block to the trip on the other side. Severing this line released both weights instantly. A detail of this is shown in Fig. 1. The weights were of lead, having a wrought iron hook, which caught the trip, and they weighed 360 pounds each. The safety batten was merely a small strip of 3 1-2 by 7-8 inches, nailed under the dog shore to keep it from falling out before the yacht was wedged up. When the weights fell they broke the safety battens, and, knocking the dog shores to the ground, released the yacht.

As the launching ways had an inclination of 1 1-16 inches to the foot, some method of checking the yacht's speed was deemed advisable. The checking was accomplished in two ways, and began to act practically as soon as the yacht was in motion. Her speed in sliding down the ways did not increase after she had gone ten feet, but continued nearly uniform, and after being water-borne she went less than 200 feet before she stopped.

The first method of checking was with two partial bulkheads, built across the cradle under the after

overhang, they were made of planks securely bolted to the aftermost poppets, and offered considerable resistance as soon as they struck the water. The second method of checking was with hawsers. A 7-inch hawser was run completely around the ship, about the low water level, forming a belt. This hawser was held in position by lines running up to the rail about every 20 feet. On each side an 8-inch hawser, secured on deck, came through the hawse pipe and was carried aft along the side, being seized to the belt hawser in five places, forming stops. To the ends of each of these 8-inch hawsers was fastened a 2,000-pound anchor buried in the ground. The weight of the yacht sliding down the ways was taken up by the stops, one by one. As the tensile strength of a stop was exceeded it broke and the strain came on the next one. Breaking these stops kept the yacht from obtaining an excessive speed. The foremost stop on both sides remained unbroken. This system of snubbing worked very successfully.

Being built in a shed, it was not possible to have any spars up. When the *Meteor* was christened and began her journey down the ways, not a flag was to be seen on board of her; yet when she floated out into the stream, she seemed alive with bunting. A large American flag flew from her jack staff aft, a string of flags fluttered from stem to top of foremast, thence to top of main mast and down to the deck again. Old Glory was at the fore, while the German Standard was at the main, surmounted by the Kaiser's private racing flag.

The effect was very pretty and the way it was accomplished was very ingenious. The masts were raised automatically by loosening a rope from a cleat. The foremast was 40 feet long and the mainmast 50 feet; both were 7 inches diameter.

Fig. 2 gives a detail of the lower end of a mast, both masts being the same. The end consists of an 8-inch channel bar, bolted to the wood mast with four 3-4-inch through bolts. At the extreme end was 900 pounds of lead, which was lashed in place. Through the channel bar was a 1 1-4-inch diameter bolt, for the mast to turn on. The masts were held flat on deck by a rope wound round a cleat, and the flags were strung on while the masts were in this position. As soon as the yacht had slid clear of the building shed the masts were freed and immediately swung round till upright.

In her launching condition, the *Meteor III.* weighed 260 tons. The time consumed in launching her from the time the men began to drive the wedges till she was in the water, was just under eleven minutes. Her general dimensions are:

THE LAUNCHING OF EMPEROR WILLIAM'S YACHT METEOR III.

Length over all	161 ft. 0 in.
" water line	120 " 0 "
Beam molded	27 " 0 "
Depth "	18 " 6 "
Draft, extreme	15 " 0 "
Displacement, loaded	315 tons.
Freeboard at lowest point	4 ft. 0 in.
" " bow	10 " 0 "
" " stern	6 " 0 "
Bulwarks	2 " 4 "
Overhang forward	18 " 0 "
" aft	23 " 0 "

Her lead ballast will weigh 110 tons, 90 tons of which was on board when she was launched.

The *Meteor III.* has been built by the Townsend-Downey Shipbuilding Company under the supervision of Mr. Theo. E. Ferris from designs prepared by Messrs. A. Cary Smith and Barbey.

The yacht is built of Siemans-Martin steel through-

out, and the weights are so distributed as to give the greatest strength on the lightest scantling. The keel is a steel plate of trough section. The stem is made up of an angle shaped to the form of a hull, beveled to receive the plating and lapped over the keel plate. The stern post and rudder frame are of forged iron. The frames and reverse frames are of angles, the latter extending down to the keel. Beams of angle section are placed on all frames. The plating is laid in inside and outside strakes. There is a water-tight steel collision bulkhead forward and one aft of the forecastle, each containing a water-tight door. The bulwarks are 24 inches high above the deck and extend continuously fore and aft and carry a teak rail. The chain locker is located below the forecastle floor.

The yacht will carry two boats and a launch, to be swung on davits, and awning stanchions made of gas pipe will be fitted from stem to stern for stretching the awning when in port.

The spars are of the following dimensions:—

Mainmast, Oregon pine,	89 ft.	long	above deck,	21½ in.	diam.
Foremast, " "	86 "	"	" "	21 "	"
Main topmast, spruce,	64 "	"	about	13 "	"
Fore " "	59 "	"	"	13 "	"
Main boom, Ore. hollow,	84 "	"		18 "	"
Fore " spruce,	37 "	"		11 "	"
Main gaff, spruce, hol'w,	53 "	"		12 "	"
Fore " " "	36 "	"		9 "	"
Bowsprit, Oregon,	52 "	"		15 "	"
Spinnaker, spruce, solid,	68 "	"		10 "	"

Spare boom, Oregon pine.

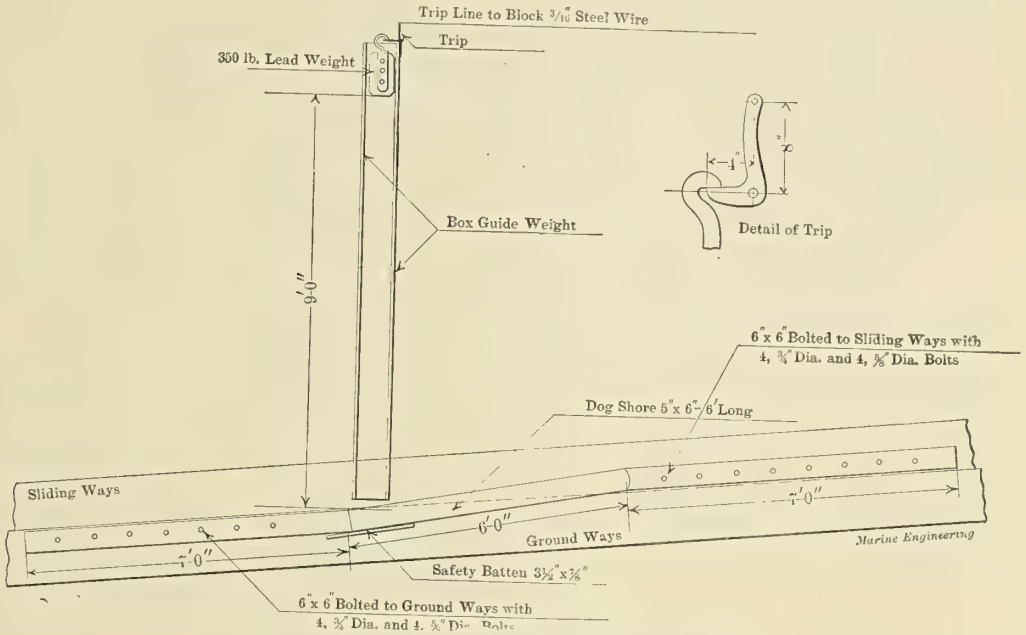


FIG. 1. DETAIL OF DOG SHORE AND WEIGHT.

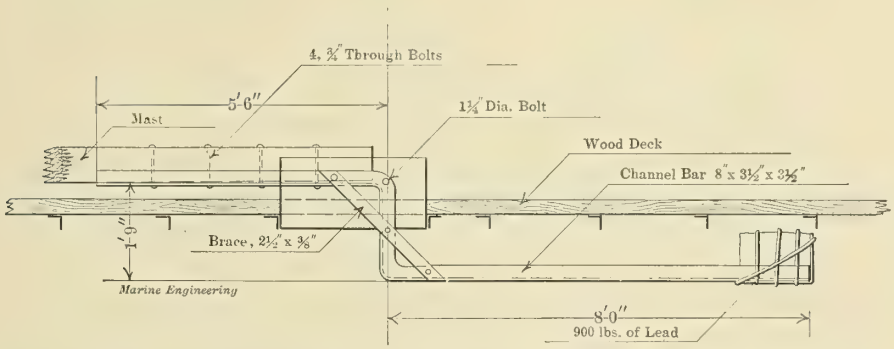


FIG. 2. DETAIL OF LOWER END OF MAST FOR THE LAUNCHING OF YACHT METEOR III.

The carpenter and joiner work are of the very best quality throughout. The deck is laid with 3 by 3 inch white pine. The companionways, skylights and ladders are made of teak, which is the wood used for finishing throughout. The deck fittings, cleats, etc., are to be of polished brass. A bronze capstan and the necessary bilge pumps will be fitted, and also a handsome hand steering gear with bronze and teak wheel.

New Electric Beacon. — The new electric beacon tested at Diamond Shoals, Cape Hatteras, threw the beam of light 23 miles.

THICKNESS OF PIPES.

BY WILLIAM BURLINGHAM.

The accompanying diagrams embody the formulae for the thickness of steam and feed pipes for marine work. The method shown is of general application and saves much time through its convenient form.

The formula plotted in diagram I is that used by the United States Supervising Inspectors of steam vessels and the Bureau of Steam Engineering. It is suitable for stationary engine work, and will pass all inspections.

The formula is as follows:—

$$T = \frac{P \times D}{8000} + .0625$$

Where T = thickness in decimals of an inch.
D = diameter of pipe inches.
P = pressure by gauge.

Tubes, water pipes and steam pipes made of Bessemer, acid or open hearth steel shall be required to show the following physical tests for use in the commercial marine:—

Elastic limit 30,000 to 35,000 pounds per square inch; tensile strength 50,000 to 60,000 pounds; elongation in 8-inch specimen 20 to 25 per cent; reduction of area 45 to 50 per cent.

The formula is for straight lengths of pipe only. A bent pipe should be made one gauge thicker than that given by the formula. It applies to straight copper pipes for steam, exhaust, bleeders, blow pipes, etc.

For feed pipes in ordinary commercial work, the formula on sheet No. 2 is required:—

$$T = \frac{1.25\ P \times D}{8000} + .0625$$

For navy work this formula as now used is

$$T = \frac{1.5\ P \times D}{8000} + .0625$$ shown on sheet No. 3.

For water pipes without pressure, P = 50 pounds.

For exhaust pipes 4 1-2 inches diameter and less, P = 20 pounds.

For exhaust pipes exceeding 4 1-2 inches diameter, P = 50 pounds.

Since the advent, during late years, of high pressure steam, it has become necessary to use steel steam pipes. The formula as used by the Bureau of Steam Engineering is as follows:—

$$T = \frac{P \times D}{10000} + .125.$$ See sheet No. 4.

To be one gauge thicker for bent pipes.

No bends must be made in copper pipes of which the radius is less than one and one-half times the bore of the pipe. Bends in steel pipe must be considered each case by itself. Copper and brass piping of 6 inches diameter and less should be seamless drawn; above 6 inches should be brazed. All steel steam pipes should be seamless drawn where practicable.

There should be no screw joints in steel steam piping. The joints will be made by flanges of stamped or forged mild steel of the same quality as specified for steel steam pipes. The pipe should be either welded to the flange or else rolled into the flange and beaded over to fit a recess, flush with face of the flange.

The inspection of copper used for the above pipe is as follows:

1. The pipe must be made of lake copper, and a chemical analysis must show that the metal is 99.5 per cent pure copper, one analysis being taken from each lot of 2,000 pounds or less.

2. The pipe must be free from indentations, cracks, flaws or other surface defects, inside and outside, perfectly round, of the specified diameter and thickness in all parts. All straight sections of pipe 6 inches in diameter or less (inside) shall be seamless drawn.

3. Each pipe must withstand an internal hydraulic pressure which will subject the metal to a stress of 7,000 pounds per square inch of section, the test pressure being calculated by the following formula for thin, hollow cylinders, but in no case will a test pressure of over 1,000 pounds per square inch be required.

P = safe internal pressure.
d = inside diameter in inches.
S = safe tensile strength of material.
(7,000 pounds per square inch.)
t = thickness of pipe in inches.

$$P = \frac{2\ t\ S}{d}$$

Every pipe must be perfectly tight under pressure and show no signs of bulging, cracks, flaws, porous places or other defects.

4. A strip 1 1-2 inches wide will be taken from each lot of 2,000 pounds or less of pipe, and must stand the following tests:—

(a) If less than 1-2 inch thick, it must stand bending flat back cold after being annealed.

(b) If 1-2 inch or over it must bend back after being annealed until the ends are parallel and the inner radius of the bend is equal to the thickness of the piece.

(c) In every case the ends of the bending test pieces shall stand hammering down hot to a knife edge, without showing signs of cracks.

5. Pipes of 2 inches inside diameter and over, for steam or feed pipes or other such high pressures, all to be subject to tensile tests; one piece of pipe from each lot of 1,000 pounds or less being selected to represent the lot. If the pipes are from 2 inches to 6 inches inside diameter, the test pieces are to be cut longitudinally. If over 6 inches inside diameter, they will be cut circumferentially. The test pieces will be heated to a cherry red and straightened when hot, then machined to the shape shown in sketch, care being taken to have the brazed seam,—if there is one,—between the measuring points.

6. For thicknesses up to and including 1-4 inch, the width of the narrow part of the test piece shall be about 1 1-2 inches. For thicker pieces the width shall be such as to give a cross section of about 1-2 square inch, but the breadth shall not in any case be less than the thickness. The rolled surfaces are not to be machined, but left in their original condition.

7. The test pieces must show an ultimate tensile strength after being annealed of at least 28,000 pounds

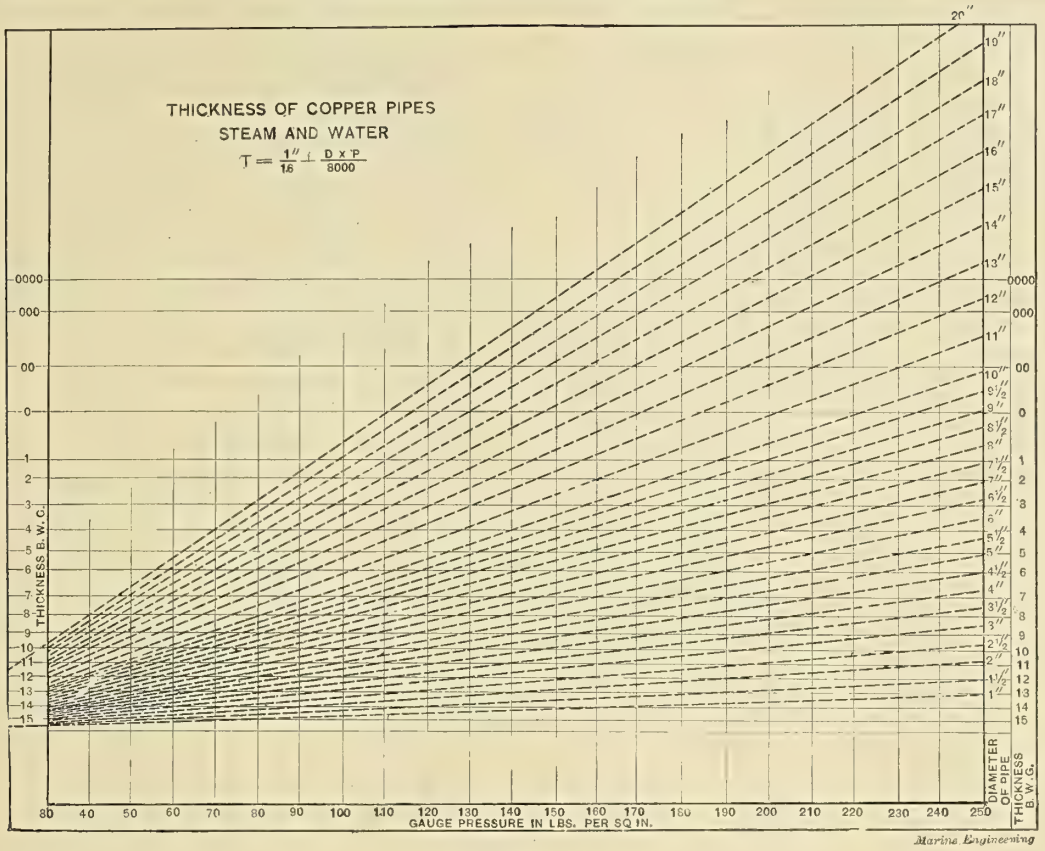

THICKNESS OF COPPER PIPES
STEAM AND WATER
$T = \frac{1''}{16} + \frac{D \times P}{8000}$
THICKNESS B. W. G.
DIAMETER OF PIPE
THICKNESS B. W. G.
GAUGE PRESSURE IN LBS. PER SQ IN.
Marine Engineering

FIG. 1.

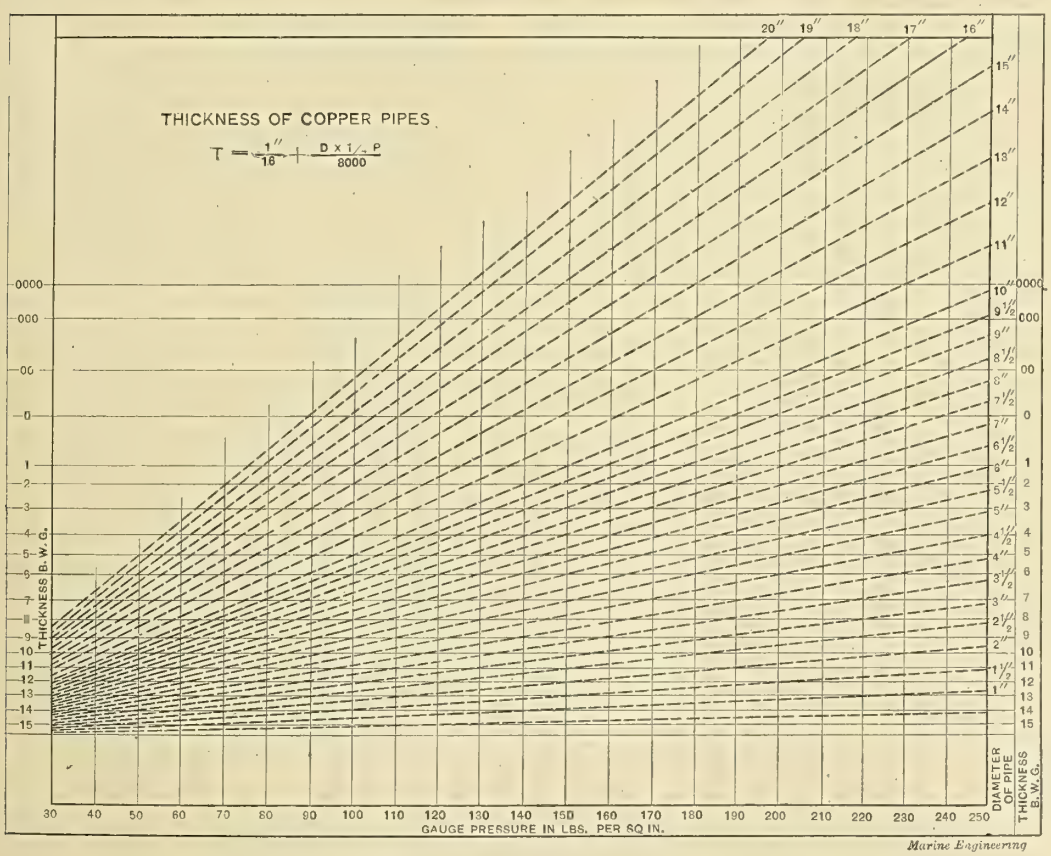

THICKNESS OF COPPER PIPES
$T = \frac{1''}{16} + \frac{D \times 1\frac{1}{2} P}{8000}$
THICKNESS B. W. G.
DIAMETER OF PIPE
THICKNESS B. W. G.
GAUGE PRESSURE IN LBS. PER SQ IN.
Marine Engineering

FIG. 2.

per square inch for all pipe, and an elongation of at least 25 per cent in 8 inches in the case of seamless pipe.

8. Every pipe must be of the specified thickness in the thinnest part. The tolerances for excess of thickness will be allowed as follows:—

Pipes up to	15	B. W. G.	.....	12	per cent.
15 "	12	"	.....	10	"
12 "	9	"	.....	8	"
9 "	7	"	.....	6	"
7 "	00	"	.....	5	"

9. The weight of every pipe must be at least equal to the calculated weight, assuming 1 cubic inch of copper pipe weighs 0.320 pound. An excess weight equal to 5 per cent of the calculated weight will be allowed.

For merchant work, all steam pipes of iron or steel, when lap welded by hand or machine, with their flanges welded on, shall be tested to a hydrostatic pressure of at least double the working pressure of the steam to be carried, and properly annealed after all work requiring fire is finished.

For naval work, steel steam and water pipes, seamless and lap welded.

1. Material. (a) The seamless pipes must be made from solid billets or disks of perfectly homogeneous steel, and cold drawn or hot rolled, as specified in the order.

(b) The lap welded steel pipes must be made of steel of a homogeneous quality, and of the grade which is found to insure the soundest welds. The skelp must be rolled true to gauge.

2. Surface Inspection. The pipe must be free inside and outside from all surface defects which would materially weaken it or form starting points for corrosion. The defects in seamless tubes to be especially avoided are: tears, snakes, checks slivers, scratches, laps, pits, rings and sinks, and in lap welded tubes defective welds, cracks, blisters, scale pits and sand marks. The pipe must be perfectly round and vary not more than one per cent above or below the gauge.

3. The following tolerances will be allowed below the specified thickness:

Pipe of all diameters not over 3 inches outside diameter, tolerance 0.01 inch below.

Pipe 3 inches to not over 5 inches outside diameter, tolerance 0.02 inch below.

Pipe 5 inches to not over 7 1-4 inches outside diameter, tolerance 0.03 inch below.

Pipe 7 1-2 inches and over, 0.06 inch below.

4. Weight. The weight will be calculated from the specified dimensions and thickness, assuming that one cubic inch of steel weighs 0.283 pound. A tolerance of 3 per cent under and 7 per cent over weight will be allowed for all pipe over 4 inches in diameter, and a tolerance of 3 per cent under and 5 per cent over weight will be allowed for pipe 4 inches outside diameter or less.

5. Hydraulic Test. Every pipe must be subjected to an internal water pressure of 1,000 pounds per square inch without showing signs of bulges, cracks or other defects.

6. Other Tests. Pipe 4 inches outside diameter and less will be tested in lots, and in the same manner as prescribed for steel boiler tubes. Pipes over 4 inches outside diameter may be tested in lots of 10, four pipes being selected from each lot, and care taken that the pipes selected for tests have had the same treatment as the remainder of the lot, i. e., that they must not be annealed or softened by slow cooling unless the others have been treated in the same way. If the inspector has any doubt that the pipes have all received the same treatment, he will test each pipe singly.

(a) Two test pieces will be cut circumferentially (when it is practicable to get a strip of the requisite length) from the ends of two different pipes, straightened when hot, and machined to shape and to a width of 1 1-2 inches. For thickness up to and including 5-16 inch, the length between the measuring points will be sixteen times the thickness. For thickness greater than 5-16 inch the length between measuring points will be 8 inches. In the case of welded pipe, the test piece must be cut so as to leave the weld in the middle. The test must show a minimum tensile strength of 48,000 pounds per square inch, and an elongation of at least 12 per cent in 8 inches, or 15 per cent in 5 inches.

(b) Two test pieces of a width equal to three times the thickness of the metal in the pipe cut circumferentially from the ends of the other test pipes, so as to include the weld, if any, shall stand bending cold at the weld to an inner diameter equal to thrice the thickness of the metal without showing cracks on the outside of the bend.

7. The failure to pass these tests in a satisfactory manner will reject the lot, unless the manufacturer desires to test each pipe separately, in which case a tensile test shall be taken from one end and a bending test from the other, and the pipe accepted or rejected accordingly.

8. If the ends of the pipes are flanged, swaged down, swelled, upset or reinforced, they will be inspected after this work is done, to see that no damage has been done by this process.

9. All cold drawn pipes must be annealed in retorts or in an improved furnace in which the flame does not strike them.

Steel Flanges for Steel Pipe. The flanges are to be forged from the solid (not welded), and are to be screwed, riveted or welded on as required by the order.

The steel of which flanges are made shall stand the following tests: The test piece to be taken from the billet or plate from which the flange is forged, and to be reduced to shape with the least amount of hammering possible. One tensile test piece and one bend shall be taken from each lot of 1,000 pounds or less.

The test shall show that the metal has a tensile strength of at least 56,000 pounds per square inch and an elongation of at least 30 per cent in 2 inches. The bending test piece 1 1-2 inches wide shall stand bending double (until the ends are parallel) without fracture (on the outside of the bend) to a curve, of which the inner radius is one and one-half times the thickness of the test piece.

Names of Masts.—The names for the seven masts of large schooners now building have been designated as follows: Fore, main, mizzen, spanker, jigger driver and pusher.

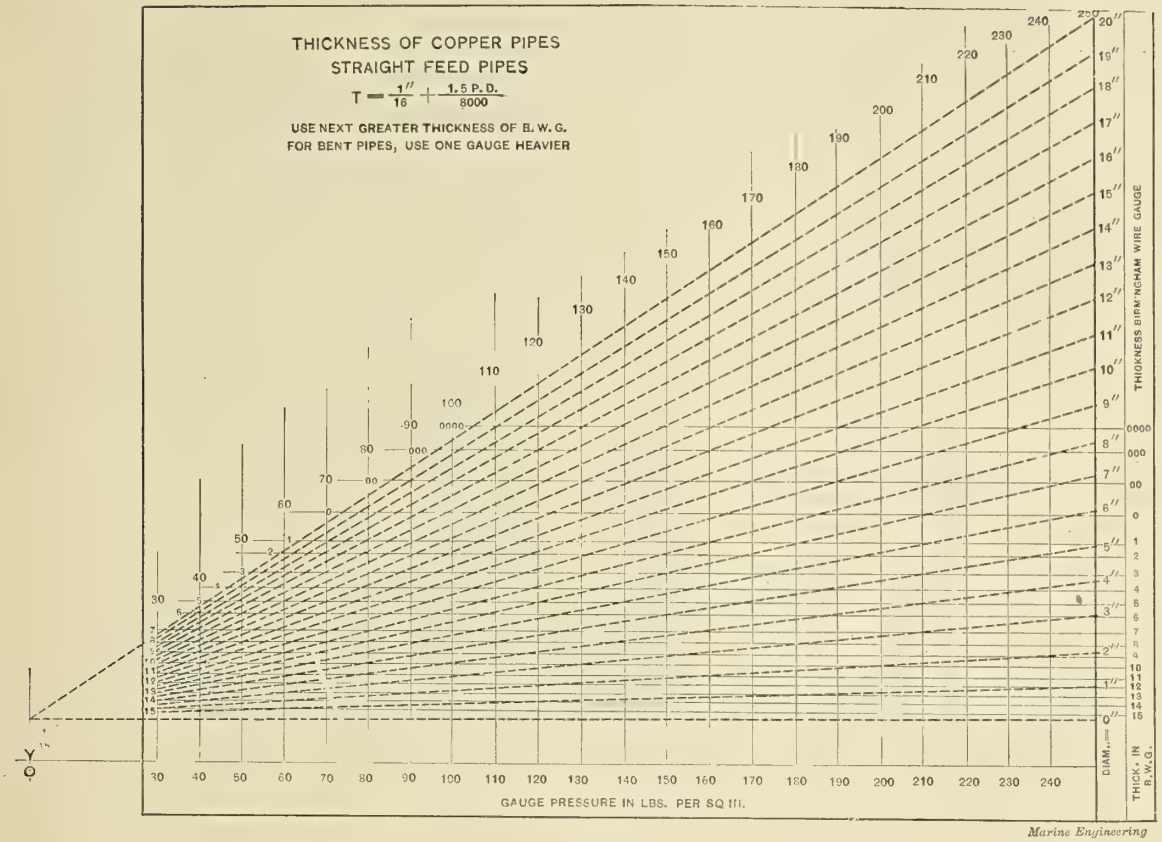

THICKNESS OF COPPER PIPES
STRAIGHT FEED PIPES
$T = \frac{1''}{16} + \frac{1.5\ P.\ D.}{8000}$
USE NEXT GREATER THICKNESS OF B. W. G.
FOR BENT PIPES, USE ONE GAUGE HEAVIER
GAUGE PRESSURE IN LBS. PER SQ IN.
DIAM.
THICK. IN B.W.G.
THICKNESS BIRM'NGHAM WIRE GAUGE
Marine Engineering

FIG. 3.

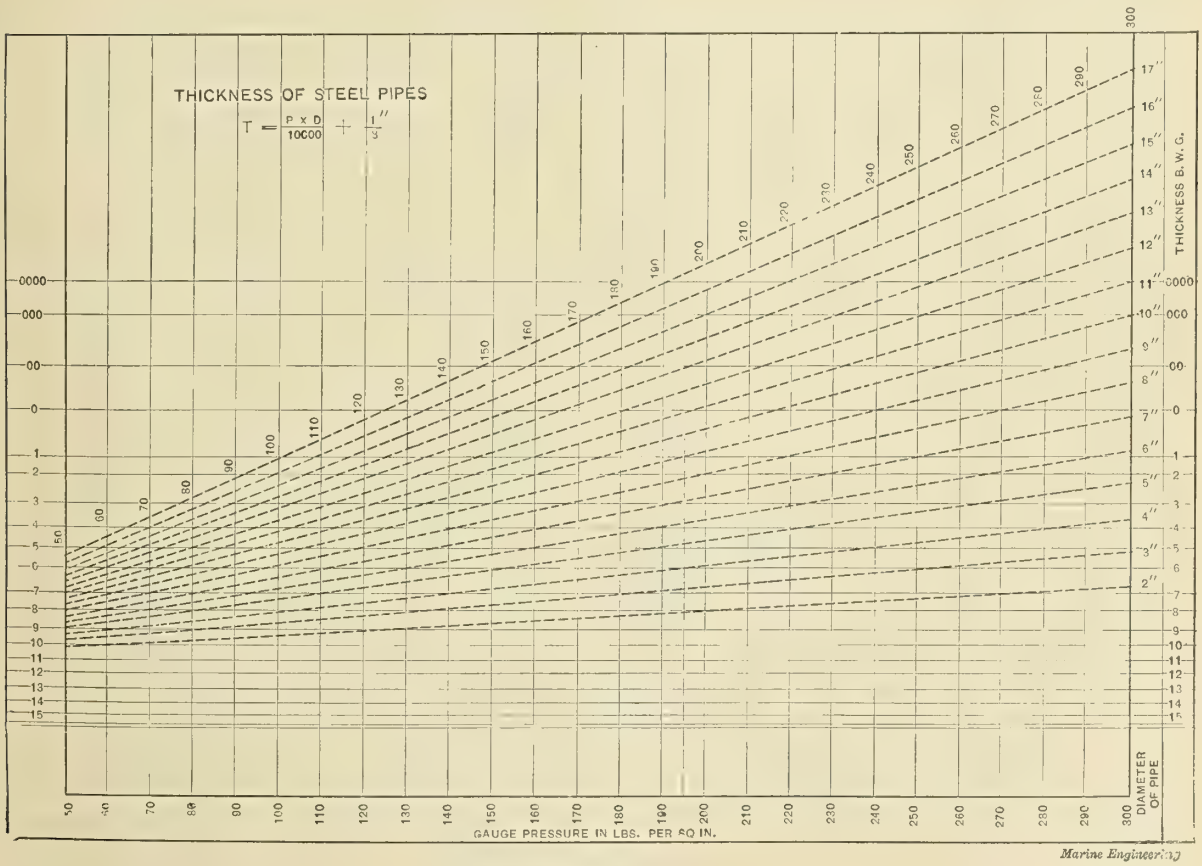

THICKNESS OF STEEL PIPES
$T = \frac{P \times D}{10000} + \frac{1''}{8}$
GAUGE PRESSURE IN LBS. PER SQ IN.
DIAMETER OF PIPE
THICKNESS B. W. G.
Marine Engineering

FIG. 4

Marine Engineering

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Notice to Advertisers.

Changes to be made in copy, or in orders for advertisements, must be in our hands not later than the 15th of the month, to insure the carrying out of such instructions in the issue of the month following.

THE proposition of Rear Admiral George W. Melville to establish at Annapolis a laboratory for engineering research, modelled somewhat after the German governmental laboratory at Charlottenburg, Berlin, is one in which all engineers must take a deep interest. The spirit of investigation and research represents the attitude of the present age toward the great problems involved in scientific and engineering progress. Now, as never before, it is realized that these problems cannot be solved by any process of abstract reasoning. Nature will reveal her secrets only to him who asks, and who asks in the right manner; and it is undoubtedly true that progress in industrial matters is in a very real manner dependent on the extent to which we interrogate nature persistently and properly regarding the problems with which we are concerned.

Admiral Melville finds in the experimental station at Charlottenburg in part, an explanation of the recent rapid advance of the Germans in industrial lines, and of their having outstripped their competitors in so many branches of industrial work.

The Admiral also points out that at the Naval Academy, where officers are trained for engineering service in the navy, the facilities for experimental work and for laboratory instruction are inferior to those which can be found in several of the leading technological schools of the country. In discussing the proposition, the statement is clearly made that several institutions in the country are turning out better engineers than the Naval Academy, with its present curriculum and equipment, and that when the Government is engaged in rebuilding and re-equipping the Academy at a cost of about $8,000,000, a feature of such great importance and of such real necessity should not be omitted from the program.

To this end an appropriation of $400,000 is asked to inaugurate the plan. An officer has also been recently sent on a tour of inspection among the leading technological schools, and much valuable information has been gathered which will be of the greatest aid in inaugurating a project of this character. The experiences of others in dealing with similar problems will thus become available, and it may be sure that the appropriation asked for will be expended in the most efficient possible manner.

We earnestly hope that Congress will look with favor on this proposition of Admiral Melville's, and that it will promptly grant the appropriation asked. With such an amount a good start can be made, and the main feature of the comprehensive plan can be well outlined. It is to be hoped, however, that the start which might be thus made will be followed up with liberal appropriations, so that further extension and development may be carried on along the many lines of usefulness which will appear as time goes on. The money which is being spent in the rebuilding of the Naval Academy is a large sum, but we are glad to see public money spent for so worthy a purpose. The Government is able to pay for the best, and it should have it. With such a general scheme, however, we believe most strongly with Admiral Melville, that an experimental engineering station is a most appropriate and necessary feature. We believe, furthermore, that from no other feature of this great enterprise, will the engineering public receive such direct benefit as from this. The questions which concern naval engineers concern also marine engineers in general, and engineers of all classes in more

or less direct manner. The freedom with which the Bureau of Steam Engineering has always given information and data to the engineering public, and the readiness which they have always shown to help along in every possible way the engineering fraternity, shows that such an experimental establishment under the control of this Bureau, would be administered for the good, not only of the Naval Service, but so far as possible for the aid and advancement of engineering science and art in their broadest aspects.

In no other way can Congress, in our opinion, accomplish with so modest an investment so much for the industrial advancement of our people, and we would call this opportunity most earnestly to the attention of our representatives, and urge in behalf of our industrial and engineering interests in their widest aspects, that this proposition of Admiral Melville's be considered favorably, and a start thus made toward the establishment of an experimental station, in which we shall, as engineers and as American citizens, be able to take a just pride.

THE present industrial situation as regards the market for shipbuilding material is of interest in connection with the influence which this condition exercises on usual methods of design and construction. Any problem involving the use of structural material, must be studied well, not only with reference to the questions usually involved, but also with reference to the supply of material likely to be found available.

In particular, all designs should be so schemed out as to avoid the use of special forms or sizes. It is hard enough to obtain regular and standard forms and sizes, and next to impossible to obtain "specials." Where time is of importance these considerations may even justify some departure from the character of design which would be dictated by engineering principles pure and simple. The question as to the extent to which such considerations should be allowed to modify the best engineering practice is one which judgment alone can determine. The practical engineer soon learns, however, that engineering is not all based on mathematics and mechanics and the laws of physical nature. He soon learns that ideal engineering can rarely be realized, and that he must continually depart from such ideals in order to realize the best all around result from the business and administrative standpoint. At no time has the demand been greater for a full realization of these facts or for a full and careful study of all such general considerations than the present.

Now, as never before, will careful study of these problems of design be found needful, and we would recommend time spent in such study as of the highest importance and as sure to bring a manifold reward.

WE are sure that our readers have received much valuable instruction and many useful hints from the series of articles on breakdowns, accidents and repairs which we have been publishing for some months, and we are desirous of continuing this series, and hope that all who may have had experiences which they believe might be helpful to others will send us their contributions.

We wish, furthermore, to extend the scope of these articles to include the modern type of marine gas engine. The small gas engine motor in its various forms is a most important factor in modern launch and small boat construction, and the extent to which it is at present in demand for such purposes would hardly be realized by those unfamiliar with the trade situation. We are now approaching the season for small boats and pleasure craft, and the use of motors of this general type seems to be likely to become more and more common. From the very nature of the case they are often or even commonly in the hands of those with little or no training as engineers, and there is, therefore, the more need for plain and simple directions for the operation of such machinery and for coping with the troubles which more commonly arise. For the latter there is no teacher like experience, and for this reason we wish to provide the means for an interchange of ideas and experiences in connection with motors of this type, especially as regards troubles, derangements, breakdowns, etc. We, therefore, especially ask all those who may have had experiences with such motors, which they believe will be of use to others, to send us their communications and thus aid in familiarizing the public with the best methods of operating machinery of this popular type.

MISHAPS AND REPAIRS.

Thrust Shaft Repairs.

Today, when forgings, no matter how mechanically intricate, are readily manufactured, it is seldom that one runs across a built up thrust shaft.

The thrust shaft which forms the subject of this article is in a British built vessel, now running to South American ports from New York. The engines were built at Glasgow, in 1888, by John and James Thompson, the cylinders being 25 inches, 41 inches and 67 inches by 42 inches stroke.

The thrust shaft originally consisted of the wrought iron shaft proper, and the halves bearing the collars, these halves being cast iron. The halves were held together by four 1 3-4 inch fitted bolts, and one iron ring shrunk on to the middle collar. Shoulders at the end of the thrust halves on the shaft prevented end play. It will be noticed in the drawing, which shows how the shaft looked after the repairs were made, that these fitted bolts passed through lugs cast on the thrust halves. These lugs, when the shaft was revolving, would churn the lubricant (a mixture of oil and water) and would throw it out of the thrust block, and to prevent a waste of money, oil was dispensed with and water only used.

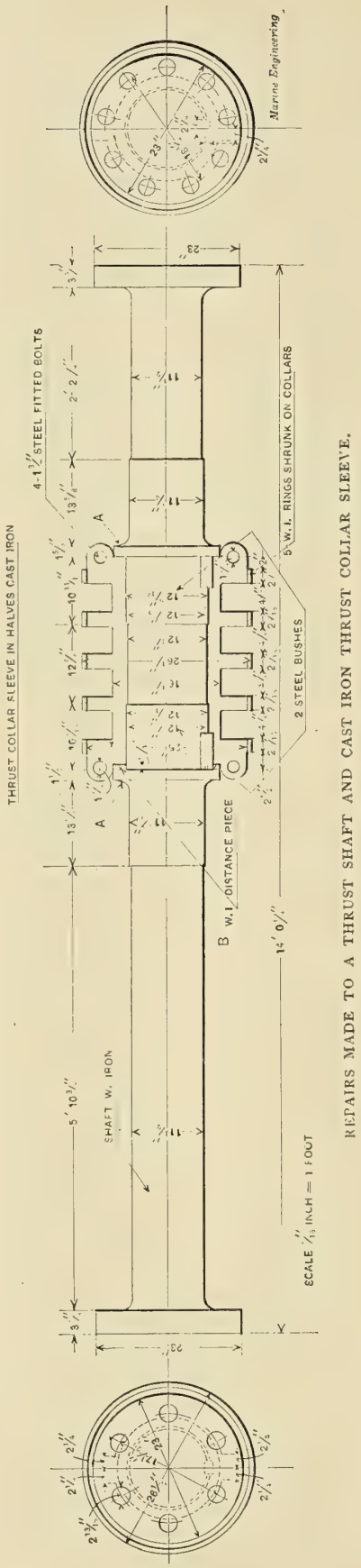
After running nearly thirteen years, the chief engineer complained of his thrust, saying that the shafting had nearly one-half inch end play, which naturally brought a strain upon the connecting and piston rods, by throwing them out of the center line, and even more, brought a severe strain upon the top and bottom end bolts. So it was decided to overhaul the thrust, and accordingly the bolts holding the halves together were driven out, and the wrought iron ring removed. When the cast iron halves were away, it was found that the portion of shaft between the two shoulders, A and A, was deeply corroded, that the keys were also quite gone, and that apparently the only thing which was still in good order was the middle part of the shaft, where the halves had been pressed to the shaft by the wrought iron ring.

The shaft and halves were taken out and sent to the shop, and how the repairs were made is readily seen from the drawing.

The shaft, in the corroded part, was turned down from 12 1-2 inches to 12 9-32 inches, thus leaving it bright and removing the corroded portion. The thrust halves were also bored out 1-16 inch larger for part of their length. New keys, 1 1-8 by 2 1-8 inches, were put in, and the distance gained by facing up the shoulders, A and A, was taken up by a 11-16 inch distance piece. Two steel plates, 9-32 inch thick, were rolled out and put into place on the shaft, the halves bolted on, and then to make the job solid, 5 rings, 3-4 inch thick and 2 3-16 inches wide, were shrunk on, with an allowance of 1-32 inch wide for shrinkage. The whole shaft was then put into the lathe and the thrust part trued up.

This shaft, in its way, is a curiosity nowadays, when few builders would go to the expense of making a built up thrust, to say nothing of the increased expense of this shaft over one of more recent practice.

It appeared to me at the time the repairs were made that the bolts would be unnecessary, and that


Marine Engineering
4-1½" STEEL FITTED BOLTS
5 W.I. RINGS SHRUNK ON COLLARS
2 STEEL BUSHES
THRUST COLLAR SLEEVE IN HALVES CAST IRON
B W.I. DISTANCE PIECE
SHAFT W. IRON
SCALE ½ INCH = 1 FOOT

REPAIRS MADE TO A THRUST SHAFT AND CAST IRON THRUST COLLAR SLEEVE.

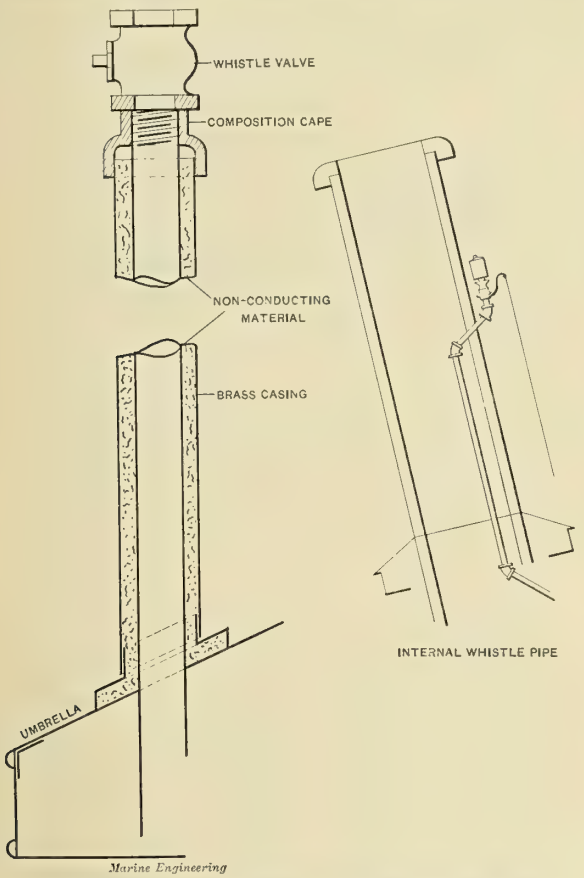
the lugs could be removed, depending solely upon the shrunk-on bands to hold the halves together; but in marine engineering we find that men are very much averse to experiments, and are well content to leave good enough alone.

If these lugs were removed it would be difficult to tell this built up thrust shaft from one of the ordinary kind, and the cause of throwing the lubricant from the thrust bearing would be removed.

D. E. F.

Troubles with a Whistle.

A whistle is a very important thing on a steam vessel. When it works well it is no trouble, but when it gets out of order and leaks, or shoots out about a barrel of water every time the rope is pulled, then is when the engineer's trouble begins.



TWO METHODS OF KEEPING A WHISTLE PIPE FREE FROM WATER.

In the summer of 1899, I was serving as First Assistant Engineer on a 1,500 ton steamer that had recently been cruising in the tropics. Nothing of any account happened to this particular whistle until we made a trip into Alaskan waters, where it is pretty cold weather, even in the summer time. As soon as we got north of Vancouver Island, it was noticed that quite an amount of water would blow out through the whistle before any sound was produced. This state of affairs annoyed the deck officers as they did not relish the idea of getting an involuntary shower bath every time it became necessary to sound a signal. The trouble became aggravated by the whistle valve beginning to leak and constantly dripping water around the deck. The Captain insisted that something should be done to stop this annoyance, so the only thing was to take the whistle down and re-grind the valve. In port this would be a comparatively easy undertaking, but to handle a whistle with a 10-inch bell, weighing 125 pounds, while swung up in a boatswain's chair, with the ship rolling and pitching alternately, is no easy matter. However, it was finally taken down, the valve removed, the seat re-ground, and the whole business put back in place again.

This stopped the leak temporarily, but it still acted like a geyser every time it became necessary to blow. After we got into Sitka we determined to try and put a stop to this blowing of water. Consequently the Chief Engineer decided to put a ½ inch drain pipe connected to the lower part of the operating valve and leading down to the feed tank to save the water. A valve was put into this drain pipe within convenient reach of the quartermaster, so that he could open the drain at intervals, and remove the water. The assumption was that the whistle pipe, which for a length of about 15 feet was exposed to the atmosphere, was acting as a condenser, and thus causing all the rush of water. Thinking now that all of our whistle troubles would be over, we anxiously awaited the time to give the new draining apparatus a trial. This came soon on our run from Sitka to Juneau. We tried the drain, and we tried the whistle. The latter still squirted out water. In addition to that the old operating valve began to leak again.

Arriving at Juneau there was nothing to do but regrind the operating valve once more. This was done, and, under test, it proved to be tight again. We stopped in Juneau two or three days, and the engineer's force had a little rest from whistle repairs. We left Juneau at about half-past ten one evening, and as it was in the month of June it was still almost light enough on deck to read a newspaper. A number of people had gathered on the wharves to see us depart, and out of compliment to them the Captain decided to give them three blasts from our old friend, the whistle. The quartermaster yanked the rope and she blew; she also continued to blow with the wildest and most wierd shriek ever heard from a steam vessel. The noise was almost deafening—no orders could be heard, and still the shrieking continued.

Finally, by pantomimic signals, the order was passed to shut off the stop valve on top of the boilers. This was quickly done and everybody breathed sighs of relief. An investigation of the whistle valve was made, and it was found that the valve and its stem and the cover had disappeared. There had been such a rush of water when the rope was pulled that it had stripped the threads off the cover, and the inner workings of the valve had taken a sudden rush off into space. The good people of Juneau are probably not yet aware of the significance of the parting salute given them that evening.

As we were underway when the accident happened, it was decided to go right along to Skagway without a whistle. How to repair the old whistle valve or

obtain a new one was, as can well be imagined, a problem. Stores where 1½ inch whistle valves can be purchased in Alaska are as scarce as the traditional hen's teeth. Luckily the White Pass railroad, running into the Klondike, had just commenced operations that summer, and through the courtesy of the master mechanic, we were loaned an old locomtive whistle which, fortunately, was fitted for a 1½ inch pipe connection. We used this whistle during the entire trip, and it certainly sounded strange to hear a locomotive whistle echoing through the hills and mountains as we would go through some narrow strait on the inside passage. One of the officers said that every time he had heard it he felt like diving into his pockets for a railroad ticket.

A new whistle valve was purchased in Seattle, and the old whistle was fixed up again. We made a return trip to Alaska, this time going as far north as Cape Nome. The whistle continued to give us trouble, and we experimented all sorts of ways to stop the rush of water but with no good result. The whole trouble came from the fact that the whistle pipe connected to the steam pipe leading to the forward steam heaters and to the steam windlass. In cool weather all the water that had collected in this entire system would rush up the whistle pipe as soon as the valve was opened. The difficulty was finally overcome by running a drain pipe from the lowest point in the forward auxiliary steam pipe to the feed tank, and putting a good steam trap in the pipe. If I had the arrangement of a steam pipe to a whistle, I would be guided by either one of the following two precepts, or, perhaps, it would be better to heed both.

1. Do not connect the whistle pipe to any other steam pipe or system of pipes, but lead it from the boilers direct.

2. Lead it up inside of the smoke stack until it is at the height of the whistle, and then lead it through the inner and outer stacks at an angle of 45 degrees. If this is impossible, by all means as an alternative, cover it with a good nonconductor, and put a neat brass casing around the magnesia (or whatever is used) as shown in the sketch.

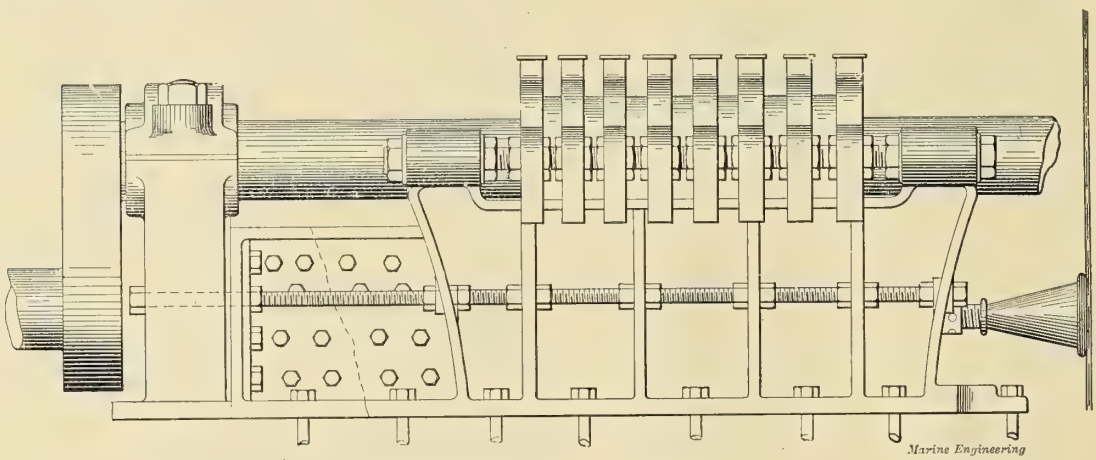
C. A. Westover.

Repairing Thrust Foundation.

The steamship *C. N.*, while entering Honolulu Harbor, H. I., picked up a line in her wheel while backing, which in a very short time slowed the engines.

The throttle was shut, but before she came to rest a loud crack was heard in the vicinity of No. 6 journal. On investigating we found the well connecting the thrust with the engine bed was cracked clear across and open 1-16 inch, the wood seating allowing the thrust to move back. There were no shops at Honolulu where we could go for repairs, so we had to do the best we could ourselves. We secured two plates 14 by 12 inches by ½ inch thick, and turned a 3-inch foot at one end, then drilled four 3 1-4 inch holes in the foot and fifteen holes in the body of the patch. It will be seen from sketch that the foot holes were there originally to bind the thrust to the engine bed, thus making the bed and thrust one solid piece.

The holes forward of the break in the casting were laid off and drilled from the plate when the foot was bolted in place, then a 1-32 inch piece of yellow metal was slipped under the foot and the remaining holes laid off and drilled. The yellow metal was then removed and the foot bolts pulled home. Then the 3-4 inch bolts were fitted, and the harder you got them the nearer the break came together.



METHOD OF REPAIRING A THRUST BLOCK.

The jack shown in the sketch was placed against an iron bulkhead conveniently near, and the thrust bearing was sent home, closing the breaks. The jack was left there as a precaution more than anything else, to take part of the load off the patches when the engines were backing. Before we left port the engines were worked full ahead, then full astern. Of course, the tendency was to close the breaks when the engines were going ahead, but the break remained the same when backing up.

We continued our voyage home to San Francisco, 2,100 miles, without any bother whatever, and on arriving the jack was supplemented by a through 1½ inch bolt passing through each rib, and jam nuts fitted as shown in sketch. This occurred in March, 1900, and the ship is still wearing the same patches and running all the time.

J. W. H.

ENGINEERS' DICTIONARY, XXXV.

Pitch. The term *pitch*, as applied to bolts or rivets, refers to their spacing, or distance between centers. Thus the stud bolts for securing the cylinder head to the cylinder may have a pitch of 5 inches, meaning that they are spaced 5 inches between centers. Or, similarly, the rivets in a boiler seam may have a pitch of 3 inches, meaning that they are spaced 3 inches between centers.

The term *pitch*, as applied to screw threads, means also their spacing or distance from one to the next. Thus a pitch of 8 threads to the inch means threads spaced 1-8 inch apart, or 8 complete turns of the thread in a length of one inch.

The term *pitch*, as applied to the screw propeller, has a similar meaning. Considering each blade of the propeller as a small part of the helical surface of a screw thread, the pitch is the longitudinal distance between two successive parts of the same spiral, supposing that it were extended round and round like an ordinary screw thread. Or, again, considering the pitch of the screw thread of a bolt from a different point of view, it may be defined as the distance which the bolt would move longitudinally for one complete revolution, supposing it to work in a fixed nut. Similarly the pitch of a propeller may be defined as the distance which the ship would move for one complete revolution of the propeller, supposing the latter to work on a smooth unyielding surface similar to that of a stationary nut.

Plunger. The piston in the water cylinder of a pump is often called a plunger. The term was formerly applied more especially to the moving part of a *plunger pump*, which see below.

Plunger Pump. A pump with parts arranged as shown in the figure. AB is the plunger, or moving part, which in this case is hollow or of the "trunk" form, and is operated by a connection at C.

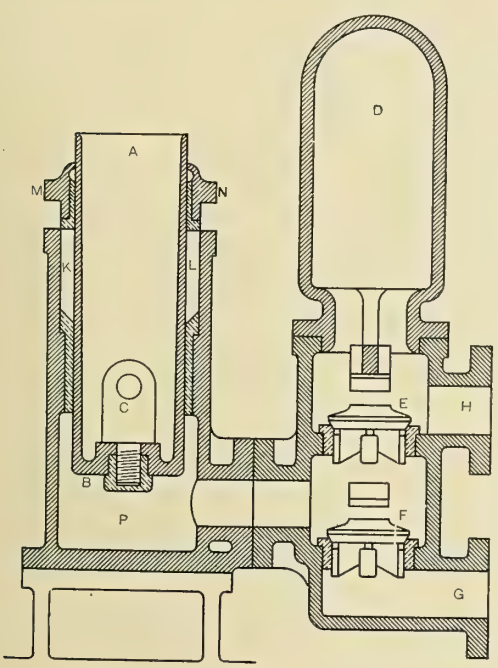


FIG. 98.

At KL is a packing space which is filled with elastic packing set up by the gland MN. In this way a tight joint between the plunger and the cylinder is formed. This is the only joint of the kind about the pump, and is always accessible for examination and adjustment. This fact gives to this type of pump one of its chief advantages. As the plunger rises the water flows in through the inflow pipe G, and valve F, to the pump cylinder P. On the down stroke the valve F closes, and E opens, admitting the water to the outflow or delivery pipe H. The air chamber D is fitted as usual on such pumps for absorbing the shock of sudden movements of the plunger, and to insure a greater uniformity of flow in the delivery pipe. Boiler feed pumps, when attached to the main engine, are usually of the plunger type, and in marine practice this forms the chief use for such pumps.

Port. An opening or passage for the flow of a vapor, gas or liquid from one chamber to another, and usually uncovered or covered by a slide valve of some type. The opening which thus admits the steam from the steam-chest to a cylinder of a steam engine

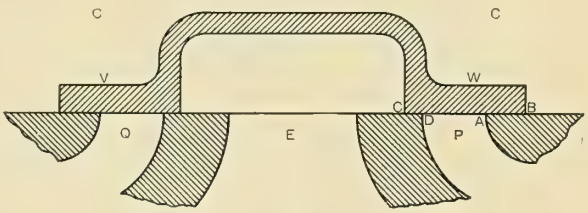


FIG. 99.

is known as the *steam* port. The opening by which the steam escapes to the exhaust pipe is known as the *exhaust* port. Thus the opening DA, controlled by the face BC of the slide valve, is a steam port providing, alternately, for the inflow of steam from the steam chest around the valve, and for its outflow to the space underneath the valve, whence it escapes to the exhaust pipe by the exhaust port shown in the middle.

Pressure-Gauge. An instrument for measuring or indicating the pressure, per square inch, in a boiler or other chamber containing a liquid, vapor or gas under pressure.

The most common type of pressure gauge is that employing what is known as a *Bourdon tube*. A gauge of this type is shown in the figure, with the tube bent in a nearly circular form as shown. The cross-section of this tube is elliptical, or oval, as shown in the small diagram, and the tube is so placed that the longer axis of this ellipse is at right angles to the plane of the figure, or to the plane of the tube. When the inside of the tube is subjected to pressure, the cross-section tends to open out and become circular in form, and as a consequence of this the tube, as a whole, tends to straighten out. This carries the free end outward, and this by means of suitable connections, as shown in the figure, is made to give motion

to the gauge pointer, the end of which swings over a suitable scale on the face.

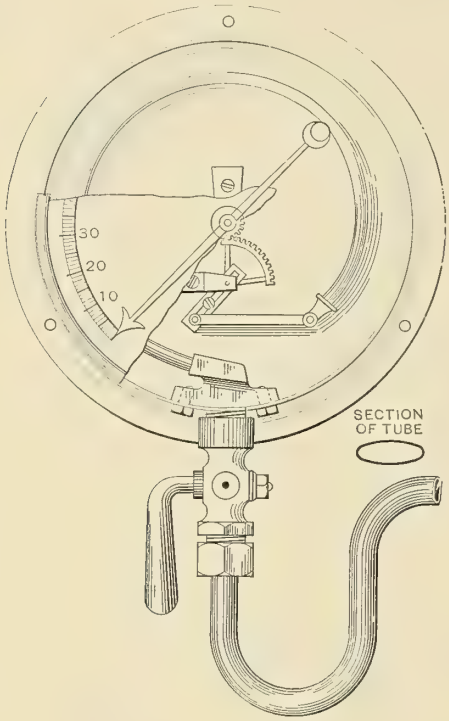


FIG. 100.

Pricker Bar. One of the tools used in caring for the fires in a boiler. It consists of an iron bar of suitable length, turned with a loop for a handle at one end, and with some 5 to 7 inches at the other end, turned at right angles, flattened down and drawn to a blunt point. It is used chiefly below the grate for clearing out ashes and refuse between the bars, and for brightening up the fire in this manner.

New Cunard Liner.—Press dispatches from England state that the Cunard Company have placed an order for a new transatlantic steamship for the New York mail route. The ship is to exceed all others in this service in speed and size.

Monthly Shipbuilding Returns.—The Bureau of Navigation reports forty-six vessels of 8,607 gross tons built in the United States, and officially numbered during the month of February, 1902. The largest steel vessel included in these figures is the ship *Atlas*, 3,381 gross tons, built at Bath, Me., for the Standard Oil Company.

Coal Consumption of Turbine Steamers.—It is reported that the turbine steamer *King Edward* burned 1,429.8 tons of coal, and covered 12,116 miles during the last season, thus averaging 8.47 miles per ton of coal. In comparison to this the paddle steamer *Duchess of Cornwall*, of about the same dimensions and of the same type, consumed 1,758.7 tons of coal, made 15,604 miles, or averaged 8.87 miles per ton. The speed of the *King Edward* was 18.5 knots, and of the *Duchess* 16.5 knots.

TROUBLES WITH BRUSHES ON ELECTRIC MACHINERY.

BY WM. BAXTER, JR.

If a generator or a motor is properly proportioned the brushes will set diametrically opposite if it is a two pole machine, and one quarter of the circumference apart if it is of the four pole type; while for any greater number of poles the distance between the brushes will be equal to the circumference divided by the number of poles. In every case, however, all the brushes must be equidistant from each other. If the configuration of the field and the poles of a machine is not symmetrical, the position of the brushes that will give the best results, as to voltage and sparking, will not be that of equal distance between them. Cases of this kind will not be considered in this article, because at the present time there are few if any manufacturers who are so ignorant of the principles upon which electrical machines act as to produce designs that are so distorted as to require that the brushes be set out of the true position.

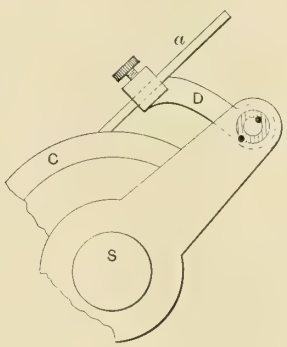


FIG. 1.

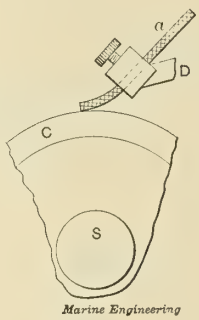


FIG. 2.

Although greatly distorted designs are not frequent in these days, it is still a fact that many machines are made in which it is the easiest thing imaginable to get the brushes out of place, and a decidedly difficult matter to set them properly. As an illustration take Fig 1, which shows a form of brush holder which, more or less modified, is extensively used. As will be seen from the diagram, if we have a two pole machine with brushes of this type, it will not be possible to have them resting on points diametrically opposite on the commutator surface, unless the angle the brush *a* makes with the commutator surface, is the same for both brushes; and as the two are on opposite sides of the shaft it is not an easy matter to determine by simple inspection whether the angles are equal or not. The point can be determined, however, by making a sheet metal gauge that will reach from the stud around which the brush-holder swings to the end of the brush. It may be well to observe that this gauge cannot be applied while the machine is running, as in such an effort there is danger of making a contact between the rocker that holds the brush and the commutator surface, or some other part that is in the circuit.

Brush holders of the type illustrated in Fig. 1 are, as a rule, supported upon a stud, around which they swing, as is shown in the illustration. The necessary

tension with which the brush presses upon the commutator is obtained by means of a spring, one end being connected with the brush holder D and the other with the stud upon which it is mounted. The tension of this spring tends to twist the stud around, and if it is not firmly held in the supporting frame such movement may result. Strange as it may appear, there are many machines in which nothing but friction is depended upon to hold the stud from turning. In such designs, if for any cause the clamping nut becomes loose, the stud swings around, and then the brush, if on the lower side of the commutator, drops down, while if on top, it dances up and down, producing serious sparking, which, if not rectified at once, may result in a short circuited armature and a burnout. A machine of this kind can be rendered safe by inserting pins of hard fiber in the joints between the stud and the insulating bushing, and also between the bushing and the supporting frame, as is shown in the illustration by the small black circles.

Brush holders of the type shown in Fig. 1 are generally used with metallic brushes, but they are also used with carbon brushes, although not so much now as a few years ago. It is not a good design for carbon brushes, as these are liable to break off by being suddenly jarred, and in such an event the results would be sure to be severe, and possibly very serious.

Of the metal brushes, the woven wire or gauze, as they are variously called, are the best; they last longer, run with less sparking, and do not cut the commutator as much as the leaf brushes. The latter type of brush is stiffer than the gauze, and in most cases they are provided with an extra thick back, which keeps them from bending. Owing to this fact brush holders, designed originally to hold leaf brushes, are not provided with means for supporting the brush near the end. In consequence of this fact, if a gauze brush is placed in such a holder it is very apt to be drawn around by the friction of its end against the commutator surface into the curve shown in Fig. 2. If a brush is drawn into this position it will not run well. In the first place it will be out of the proper position for sparkless running—that is, if it was set in the true position when straight. In the second place, it will produce an unnecessary friction and may result in cutting the commutator badly. The easiest way to prevent this trouble is to cut a piece of spring metal, preferably brass, about one-thirty second of an inch thick, and place it in the brush holder so that it may reach nearly to the end of the brush, as is shown in Fig. 3 at b.

Gauze brushes should never be placed in holders intended to hold carbon brushes in a position perpendicular, or nearly so, to the commutator surface. Gauze brushes will not run well in such a position, but must be held in inclined holders, as in Fig. 3. Carbon brushes can be used in connection with brush holders that clamp them tightly, or in holders that allow them to slide through. In the latter type of holder the brush is pushed endwise through the holder against the commutator surface. Gauze brushes cannot be used in holders in which the brush is intended to slide endwise, but must be firmly clamped by the holder, and the tension against the commutator surface must be obtained by forcing the brush holder against it.

Formerly it was customary for dynamo tenders to remove the brushes every day and file them up on the end so as to make a good contact with the commutator. This practice is not good, and has been abandoned almost entirely. The only benefit derived from the filing up process was that the scraggly ends and corners were removed. Outside of this, however, the filing did more harm than good, because it is not possible under ordinary conditions to file the end of a brush so that it will properly fit the commutator. The best way to treat metallic brushes, whether leaf or gauze, is to turn them upside down every few days so that they may be worn into the shape of a chisel end—that is, tapered on both sides. In this way the most perfect fit obtainable in practice is secured, for the end of the brush, being worn away by rubbing against the commutator surface, must be a perfect fit. The brushes should not be turned too often, for every time this is done the contact will be imperfect

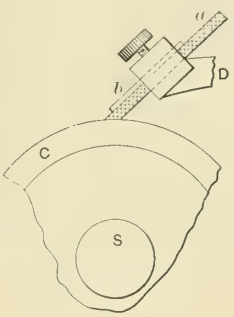


FIG. 3.

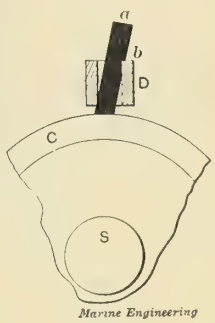


FIG. 4.

for some hours, until the metal has been worn away sufficiently to bring the whole width of the brush into contact. When the bevel that is running against the commutator is about twice as wide as the other one it is time to turn the brush over. This turning of the brushes over, so that they may trim themselves, in addition to saving time and trouble, possesses the advantage of making possible the use of thicker brushes, which will not only last longer, but, in addition, retain their shape better.

Carbon brush holders are made in many forms, some being very simple and others decidedly complicated. Many designers appear to believe that there is great difficulty in conveying the current from the holder to the brush unless the latter is tightly clamped, and on that account provide a frame in which the brush is secured, and this frame slides in the brush holder proper. This construction is entirely unnecessary, for even if the brush is very loose in the holder there will be no difficulty experienced on account of the current not passing to it freely. In some brush holders springs are provided to press against the brush, so that while it can slide through it is at all times hugged by the springs, and in that way a good contact is insured. The objection to this

arrangement is that on account of the pressure of the springs against the brush the latter is liable to stick occasionally unless the pressure with which it is forced against the commutator is much greater than is necessary, so far as sparkless running is concerned. Of all the many types of brush holders that have been devised, those in which the brush can slide through freely are the best—that is, of the designs in which the brush holder is stationary.

In some cases, where the brush is not pressed against the commutator by a properly shaped or supported lever, chattering becomes possible, and this may cause sparks to pass between the sides of the holder and the brush. If this action is allowed to continue, the brush may become worn away so as to hang on the edge of the holder in the manner illustrated at *b* in Fig. 4. When this occurs the result will be that after a while the pressure of the brush against the commutator will be reduced on account of the impossibility of the brush advancing, and when this state is reached there will be increased sparking. To obviate such trouble the best course to pursue is to file off the corners at the upper end of the brush holder so that the brush cannot become caught, and then endeavor to ascertain the defect in the pressure lever that allows the brush to chatter, and remedy this also. In Fig. 4 the brush is made decidedly too small for the holder, but this is done so as to illustrate the action more clearly. In practice the clearance between the holder and the sides of the brush need not be more than one or two hundredths of an inch, as the brushes are made very nearly of uniform width.

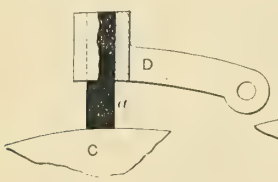


FIG. 5.

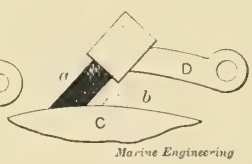


FIG. 6.

In all forms of carbon brush holders in which the brush slides there is no danger of the brushes being improperly spaced as the brush advances endwise, and therefore always strikes the commutator surface at the same point. In many of the forms of holders in which the carbon brush is clamped, there is every possible chance for the brushes to become improperly spaced. If a brush is held in a brush holder of the form shown in Fig. 5, there will be very little shifting of the position of the end of the brush upon the commutator surface as the brush wears away, for the simple reason that the brush is held in a line that is square with the radius drawn through the center of the stud around which the holder D swings. If, however, the brush is held in an inclined position, as in Fig. 6, then as the end of the brush wears away and the brush holder D swings around, the position of the brush with respect to the commutator will be changed, as is clearly shown by the broken lines *b*. From this it will be seen that with brush holders of the latter type it is necessary that the length of brush extending beyond the holder be the same in all, for if not, some of the brushes will be set in advance of the proper position, and some back of it, and under such conditions sparkless running cannot be obtained.

A great many people believe that lubricating the surface of the commutator is decidedly advantageous, and many commutator compounds are advertised that are claimed to work wonders in the way of suppressing sparking. It is a well demonstrated fact that when judiciously used, a small amount of lubricant reduces the friction, and thereby tends to keep down the temperature of the brushes, and thus to some extent reduce the sparking. On the other hand, unless the lubricant is used very sparingly, it is liable to do more harm than good, for when combined with the carbon dust from the brushes or the metallic particles detached from the commutator it becomes a fairly good conductor and may assist in establishing short segments between the segments. Owing to this fact it is safe to say that if a commutator runs well the best course to pursue is not to use lubrication of any kind upon it.

French Torpedo Boats.

After successful trials the torpedo boats *Bourrasque* and *Rafale*, built by Augustin Normand and Company, of Havre, France, were delivered to the French Government. They are of the *Cyclone* unprotected class, with the following dimensions: Length on load line, 147 feet 6 inches; extreme breadth, 16 feet 7 inches. The weights carried on trial exclusive of chains, anchors, masts, boats, etc., and comprising only torpedoes, torpedo tubes, compressing pump, artillery, ammunition, provisions, water for crew and boiler, coal necessary for steaming 1,020 nautical miles at 14 knots, crew and effects, amounted in all to 34.5 English tons in the *Bourrasque* and 39.2 tons in the *Rafale*, the displacements being 153.3 and 158 tons, respectively.

The full speed trials, which took place after the ordinary preliminary runs on the measured mile, were of four hours' duration. The first hour was to be run at 25 knots minimum, the next hour maximum speed, and the remainder of the time at 25 knots speed. The one hour maximum speed was 31.53 knots for the *Bourrasque* and 31.41 knots for the *Rafale*. The mean of the three other hours was 25.79 and 26.20 knots, respectively. The boilers are of the Normand type.

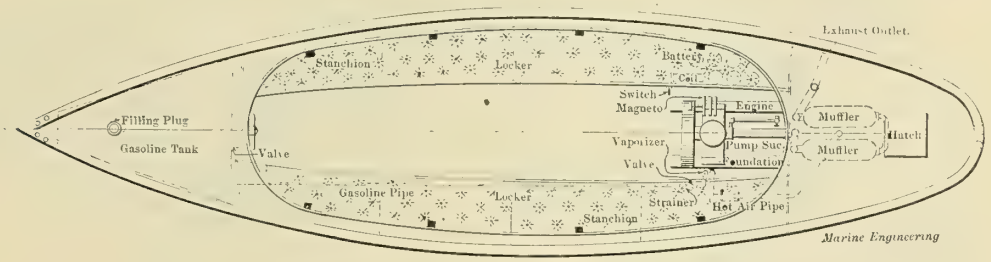
Order for Tugboat.—Theodore Smith's Sons and Company, Jersey City, N. J., have received contract for an 80-foot tugboat from the United Fruit Company, Boston, Mass. When completed the boat is to be used in Cuban waters. They also have orders for two dredges.

Oil Fuel at Sea.—An important incident in the progress of crude petroleum as fuel was the arrival recently in the Thames of the steamship *Murex*, from Singapore via Cape Horn. This is the longest voyage yet undertaken with oil as fuel. It is stated that the estimated saving in good Welsh coal was about seven tons per day, which estimate is based on previous trips of this steamer over the same route. It is also stated that only three firemen were employed, whereas the former force for handling coal was twenty-four.

ENGINEERING SPECIALTIES.

Gasolene Pleasure Launch Dorothy.

The accompanying illustration shows a pleasure launch, the motive power of which is furnished by a gasolene engine. The launch is 22 feet 3 inches over all, 19 feet 2 inches on the water line, 5 feet 6 inches beam and 2 feet 9 inches deep. The keel is of white oak, sided 3 inches, molded 5 inches; the stem and stern post are of white oak kneed into the keel; the frames are of white oak, sided 1 1-4 inches, molded 1 1-2 inches at keel, and 1 inch at head; the clamps are of white oak 3-4 inches thick and 3 inches wide; the sheer strake, plank sheer and coaming are of quartered oak, polished; the planking is of white cedar 7-8 inch thick; the deck is of white pine, polished. The stanchions and carlines for standing top are of white oak, the top is white pine, covered with No. 12 canvas, and painted; this top has a hatch fitted in it for convenience in getting in and out of the boat. The inside of launch is finished in cherry, and fitted with extension lockers and cushions, so that six persons can sleep comfortably, while on an outing. The top is fitted with storm curtains, a lookout being provided in the bow curtain, so that it will not interfere with the steering of the boat.



22 FOOT GASOLENE PLEASURE LAUNCH.

The motive power is a four horse power Lozier gasolene engine; the propeller is of bronze, twenty inches diameter, with a pitch of thirty-six inches; it is of the reversing type, with two blades, and turns 340 revolutions per minute. The shafting, shoe, stuffing box and rudder are of bronze, in order that the launch may be used in salt water.

The tank is of copper, 52 gallons capacity, and fitted in the bow space, but arranged so that it can be taken out at any time. This is accomplished by keeping it up, so that it does not come below the top of the lockers, except in the middle of boat where it will clear them in sliding in place. It rests on a floor built in the bow of the boat; this floor is made to conform to the bottom of tank, so as to stiffen the bottom. At the sides, top and each end, are fitted braces well secured to the boat, so that when the tank is in place it is thoroughly secured, which is very desirable in a small boat on a rough sea. Copper bulkheads, or stiffeners, are fitted to the inside of tank; these also act as swash boards.

The tank being fitted above the lockers on the sides, and only a little below them in the middle, insures a gravity flow of oil to the engine until the tank is dry. The tank was first riveted together and the inlet and outlet nozzles riveted on, and then everything was soldered up to make a tight job.

The piping from the tank to the engine is of brass, and is run through one of the lockers, with a valve on the tank and one at the vaporizing valve near the engine. As a needle valve, such as is fitted to a vaporizer, cannot be depended upon to remain tight, an additional valve was placed in the piping. In the piping just forward of the after stop valve is fitted a strainer which can be taken out at any time. This was put in to thoroughly strain the oil the second time before it goes to the engine.

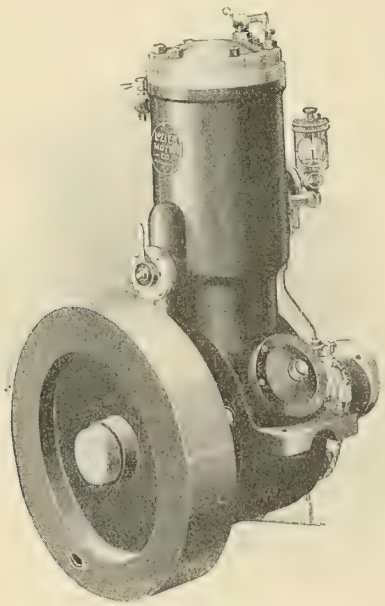
Too much care cannot be taken to clean the oil, as this is important in a good working gasolene engine, where the supply is regulated with a needle valve, as the opening in such a valve is very small, and any dirt collecting in it will soon reduce the opening so that the engine will slow down and finally stop.

The piping from the tank to engine is of brass, and the threads on pipe and fittings were tinned first, then screwed up and sweated together, thus making a thoroughly tight job throughout.

The illustration shows the Lozier engine, as fitted in the launch; it is a two cycle, four horse power motor, making 340 revolutions per minute.

The vaporizer is secured to the crank case. The oil and air passing through this valve is thoroughly mixed on entering the crank chamber. As the piston ascends, the mixture is drawn through the vaporizer into the crank chamber, and when the piston descends, the valve in the vaporizer closes and the charge is compressed in the crank chamber, and the piston, on reaching the lower end of stroke, opens a port connecting the cylinder with crank case, causing the charge to rush into the cylinder through the port striking a baffle plate, secured to the top of the piston, so that it is directed up to the top of cylinder, thus forcing the burned gases out of the top of cylinder down through the exhaust port into the exhaust pipe. As the piston returns on the up stroke, these ports are closed, and the charge is again compressed in the top of the cylinder, and then ignited at a point as already determined upon by the adjustment of the ignitor mechanism. If the spark is caused by batteries, the contact should be as short as possible, as the life of the batteries greatly depends on the length of contact; if a magneto is used, a much longer contact can be made. A throttle valve is fitted in the port, with a convenient handle, so that the charge entering the cylinder can be throttled, and the engine can be run at any desired speed below the maximum, by simply

turning this handle until the desired speed is obtained, no other change being necessary. By this method a rich mixture is always drawn into the cylinder, which insures a perfect ignition at all speeds, and only using the amount of oil necessary for the throttled charge. With this throttle the engine can be slowed down in the same manner as a steam engine. The ignitor is worked by an eccentric from the main shaft, and, if necessary, it can be adjusted while the engine is running. The switch on top of the cylinder head is the main switch, and can be thrown out or in by lifting it up or dropping it down. The water circulation is very complete, as it passes around the cylinder through the cylinder head, and passes off around the exhaust pipe, thus keeping all parts of the engine cool. The water is circulated by a rotary pump, driven by chain and sprocket wheel from the main shaft. The main bearings are of bronze, and in addition to the crank case oiling, they are fitted with compression



LOZIER GASOLENE ENGINE.

grease cups, conveniently located. Oil is put into the crank case for oiling the internal parts; the lower end of crank pin bearing has a wiper secured to it, so that oil is well distributed by it at each revolution of the engine.

The thrust bearing is of the ball bearing type, and fitted to the shaft so that it is adjustable for wear.

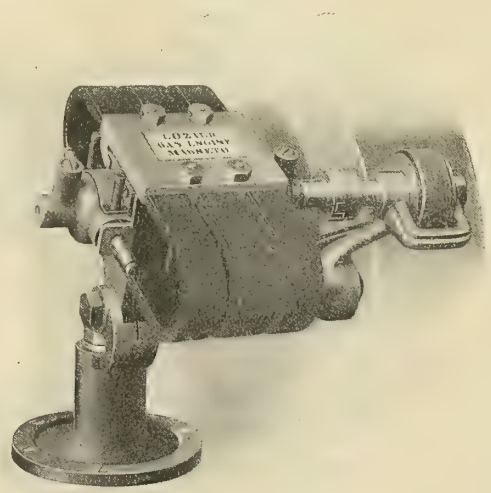
The magneto is secured to the engine proper, and fitted with a flexible shaft and ball bearings, so that the friction wheel is always held firmly against the fly wheel, thus doing away with the rigidity which would tend to overheat the bearings of the magneto.

There are six batteries, so that the engine can be run on the batteries or on the magneto at will, by simply throwing in the switch for either. The batteries are always used in starting the engine; after it is started, the magneto is substituted.

There is a double muffler placed in the exhaust pipe under the after deck, which reduces the sound of exhaust to a minimum; this sound cannot be heard when sitting in the boat on the opposite side from the exhaust outlet.

A hot air box is not used in connection with this engine, the hot air pipe taking air from between the two mufflers, these being covered over on top and down the sides by asbestos paper, thus forming a hot air pocket, and by this means all the hot air is drawn out of the space under the after deck.

The engine foundation is of white oak, a keelson on each side of the keel, notched over the frames and let down and fitted to the planking. There are three athwartship pieces notched into these and secured by through bolts to the keel. The fore and aft keelsons are held together by through bolts, so that the engine foundation is solid with the boat, as if of one piece. It is very important to have a good, solid foundation fitted in a boat, when a gasolene engine is to be installed, as the vibrations will soon work it loose if it is not properly put in.



MAGNETO SPARKING DEVICE.

Pipe Expanding and Threading Machine.

The Lovekin expanding and flanging machine, as shown in the accompanying figure, is a machine designed to meet the demands of shipbuilders and engineers generally where a large amount of wrought iron, steel and copper piping is used, and where such piping is required to be expanded tightly in the flange as well as beaded over the same. It is designed with a view of dispensing with the common practice of screwing flanges on pipes, especially so when such pipes are subjected to the action of salt water or to any vibration. When it is considered that the piping throughout ballast tanks is usually made of wrought iron for salt water, and after being galvanized, has a thread cut on same to receive the flange, it is evident that the life of the pipe is of short duration, as it will corrode at the bottom of the thread first and is a continuous source of trouble. On the other hand, by the use of this method the thickness of the pipe remains uniform throughout, and can therefore be a much lighter gauge for the same lasting qualities. Furthermore, in the case of copper pipes, instead of destroy-

ing the copper by hammering the same into a flange, this machine does a perfectly uniform piece of work throughout, and no comparison can be made as to the character of its tightness.

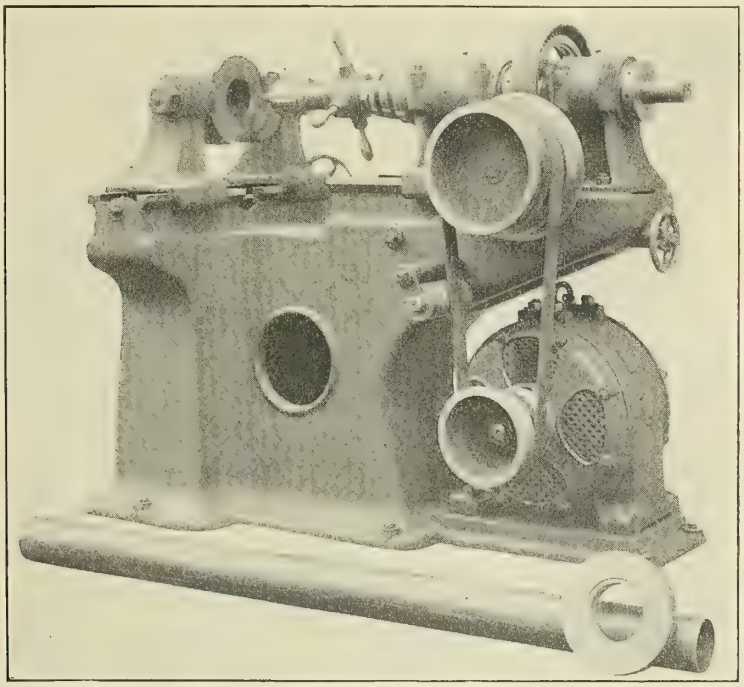
Samples of copper pipe which have been expanded with this machine, and without any brazing whatever, have been tested to rupture with 2,000 pounds pressure per square inch on a four-inch pipe, during which there was not the sign of a leak. Comparative tests between pipes brazed and hammered in, and those done by this machine without any brazing, have been made as to their pulling qualities, and in every case the pipe has broken at the point of brazing at the back of the flange, thus proving the superiority of the one not brazed.

The machine is supplied with a three-horse power electric motor, or can be run by counter shaft overhead, and the one shown in the engraving has a complete set of fourteen tools, clamps and jaws from 1 1-2 inches to 8 inches in diameter.

The tools usually furnished with this machine are for expanding the ends of the pipes so as to make contact between the ends or expanded inner surfaces. Tools, however, may be furnished for making any type of joint, particularly the flanging of seamless drawn tubing for steam pipes of high pressure as adopted by the United States Navy Department, the British Admiralty and other governments for their most recent cruisers, battleships, etc. For this class of work a cutter is provided for simultaneously expanding, flanging and facing off the end of the tube so as to make a perfect joint without removing pipe from the machine.

The time necessary to do the work on this machine is as follows: For iron or steel 4-inch pipe 3-16-inch thick, 10 minutes; 8-inch pipe 5-16-inch thick, 20 minutes. Copper pipe requires a trifle less time. Where extra heavy piping is required special tools are provided to do any thickness of tubing without the possibility of breakage.

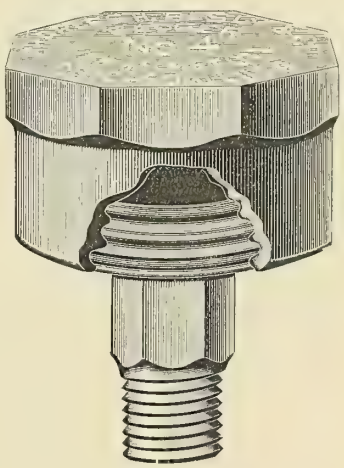
Further information may be obtained from the Keystone Machine Tool Works, Philadelphia, Pa.



PIPE EXPANDING AND THREADING MACHINE.

New Oil Cup.

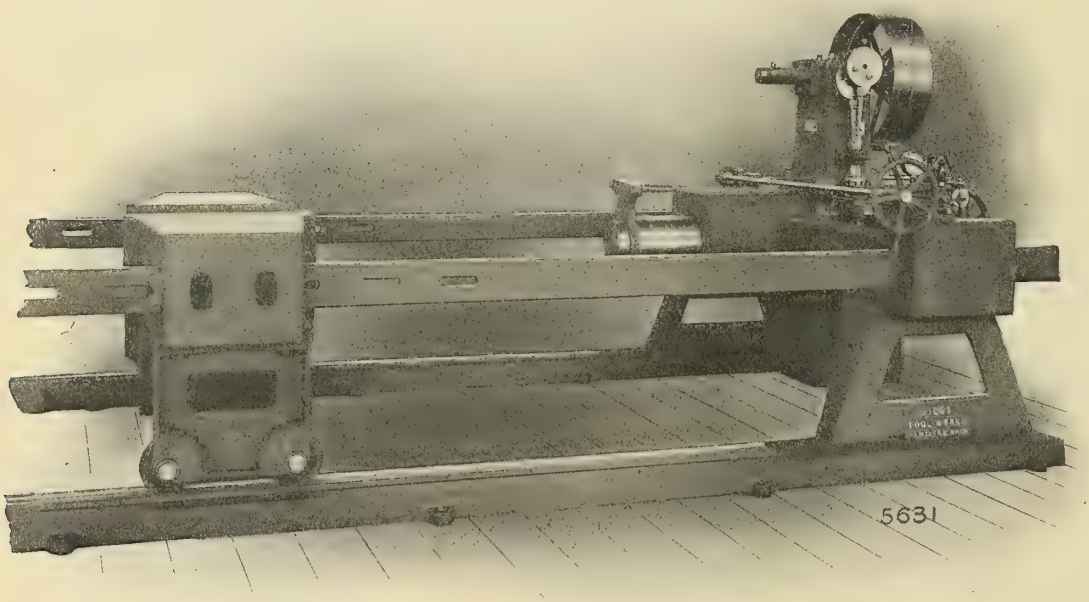
Messrs. Charles H. Besly and Company, 10 North Canal street, Chicago, Ill., have placed on the market a new oil cup which is especially adapted to be used with Helmet oil. It is called the Badger oil cup and is illustrated in the accompanying cut. It has an octagonal cap and can be operated by hand or wrench. The base of the cup has a round thread with hexagon



A NEW OIL CUP.

steel stem threaded, screwed into base and extended. As shown in the sectional view, the thread in both the cap and on the base is round, thus decreasing the possibility of the threads stripping, crossing or clogging. This cup can be used on all classes of machinery and among the advantages claimed for it are that it will neither leak nor break. It is made in six sizes ranging from 1 1-4 to 3 5-8 inches outside diameter, with pipe thread of from 1-4 to 1-2 inch.

Upon application to the manufacturer, a sample of this cup will be mailed to intending purchasers, together with prices and full descriptive matter.



HORIZONTAL HYDRAULIC FORCING PRESS.

Horizontal Hydraulic Forcing Press.

A design of a horizontal hydraulic forcing press has recently been placed on the market by the Niles Tool Works Company, Hamilton, Ohio, and is made in sizes of both 300 and 400 tons capacity. The 400-ton machine is here illustrated, although both are of the same design. The machine stands parallel with the line shaft, and the tie parts are placed at the sides, leaving the top free for crane chains, the machine being mounted on two parallel base plates, on which the sliding head rolls. The cylinder is bored true, and is lined with copper, which is expanded into place and burnished. Cup leather packing is used on the piston. The ram is 14 inches diameter with a stroke of 48 inches, and is counterweighted so that it returns automatically when the release valve is opened. The safety valve placed in a box cast on the cylinder may be set to open at any desired pressure, and then the box can be locked up. The pressure gauge is graduated in both total tons pressure on the ram and pounds per square inch of its area. The pump is double acting and is controlled or stopped by trip valves without necessitating shifting the belt. The discharge from the cylinder is led into a tank bolted underneath, from which the pumps take their supply.

This machine can be used for building up crank shafts of large dimensions. The distance between the tie rods is 8 feet, that between the ram to the sliding head 30 feet, and there is an opening in the head for 30-inch shafts.

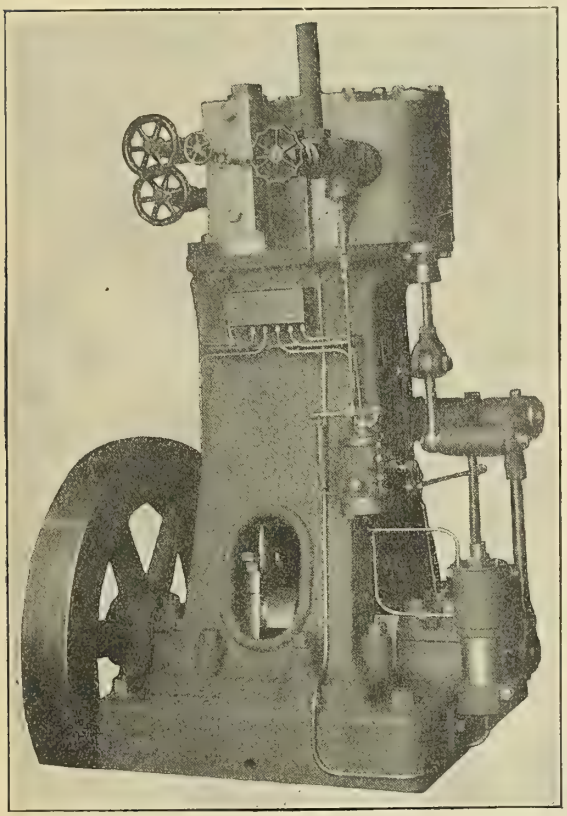
Carbonic Anhydride Refrigeration.

The adoption of refrigerating machinery on board yachts is becoming quite general, now that a machine is on the market which embodies the three features of safety, compactness, and efficiency. The objection raised to the ammonia machine is the annoyance in case of leakage and the danger of a possible explosion. The dense air system is rather heavy and cumbersome. Until recently the other safe system, the carbonic anhydride compression, has only been obtainable in Europe, but now an American machine has been placed on the market which will doubtless have a large sale on board ship.

The accompanying cut shows the vertical direct-connected steam-driven compressor for carbonic anhydride refrigeration built by The Cochran Company of Lorain, Ohio. The steam and compressing cylinders with their cross heads are carried on a single frame, supported in turn upon a rigid bed-plate in which are formed bearings for the crank shaft. The shaft is of unusually large diameter, and its two cranks are so placed as to give the best possible distribution of power and load. Piston valves are used, the valve itself being a simple cast-iron disk, readily replaced at small expense when worn, so that the steam cylinder may be operated without internal lubrication, a very desirable feature for marine use. The various

journals are lubricated from a large oil-box placed at a convenient height. The compressing cylinder is made from a solid steel forging, and is thus of great strength and absolutely gas-tight. The packing of the piston-rod is done by cup-leathers as usual, and a direct-connected oil-pump is provided to automatically maintain the proper pressure between the leathers and thus prevent the escape of gas. All valves of the compressing cylinder are of nickel-steel, and each one is instantly accessible by removing a threaded cap, and all are interchangeable.

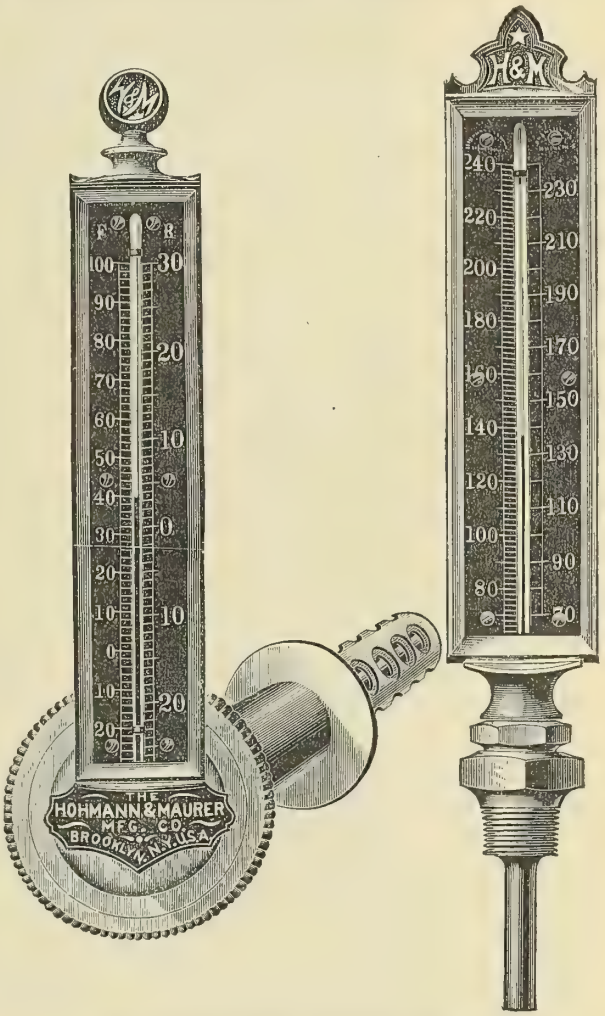
Gas condensers for these machines are fitted with copper pipe, thus giving a long life to the apparatus using seawater for condensing purposes. All pipe fittings are of steel forgings or castings, and every fitting and piece of pipe used is tested under 1,500 pounds air pressure while submerged in water, and thus proved absolutely tight.



CARBON ANHYDRIDE REFRIGERATING MACHINE.

Of these vertical machines three sizes are made, having capacities equal to the melting of two, four and six tons of ice per day of twenty-four hours. For placing the apparatus in a confined space, such as the shaft alley, the compressor, condenser and brine-cooler of these small sizes are made in separate units, so as to be placed separately in whatever space is obtainable. Larger machinery is of the horizontal type, with condenser constructed in the base of the machine. Electrically-driven machinery is also made for use when this method of driving is preferred.

The Cochran Company has supplied its machinery to the yachts *Conqueror* and *Corsair*, and steamers of the American Line, and is prepared to furnish from stock duplicates of successful machinery already constructed, of capacities from one-half to fifty tons of refrigeration per day, in single units. The presence of these machines cannot be detected by noise or by odor. Their weights are not excessive and the steam consumption is small. Carbonic anhydride to replace the slight leakage, is cheaply purchasable in any large city, and a supply for many months occupies but li tle room. By the use of this machine the yacht owner may exchange a ton of coal for from five to fifteen tons of ice or its equivalent in refrigeration.



THERMOMETERS FOR ENGINE ROOM USE.

Thermometers on Board Steamship.

Every seafaring man is familiar with the thermometer, so called, since it plays so important a part in his daily observations. However, the thermometers here described should be properly called temperature indicators, and by their use the economic operation of a ship may be increased. Beginning with the boiler equipment, the importance of attaining correct records of the temperature of the feed water heater, hot well, inlet and discharge from the condensers, is appreciated by every engineer. Careful watch must be kept on the pressure and vacuum gauges, which for certain

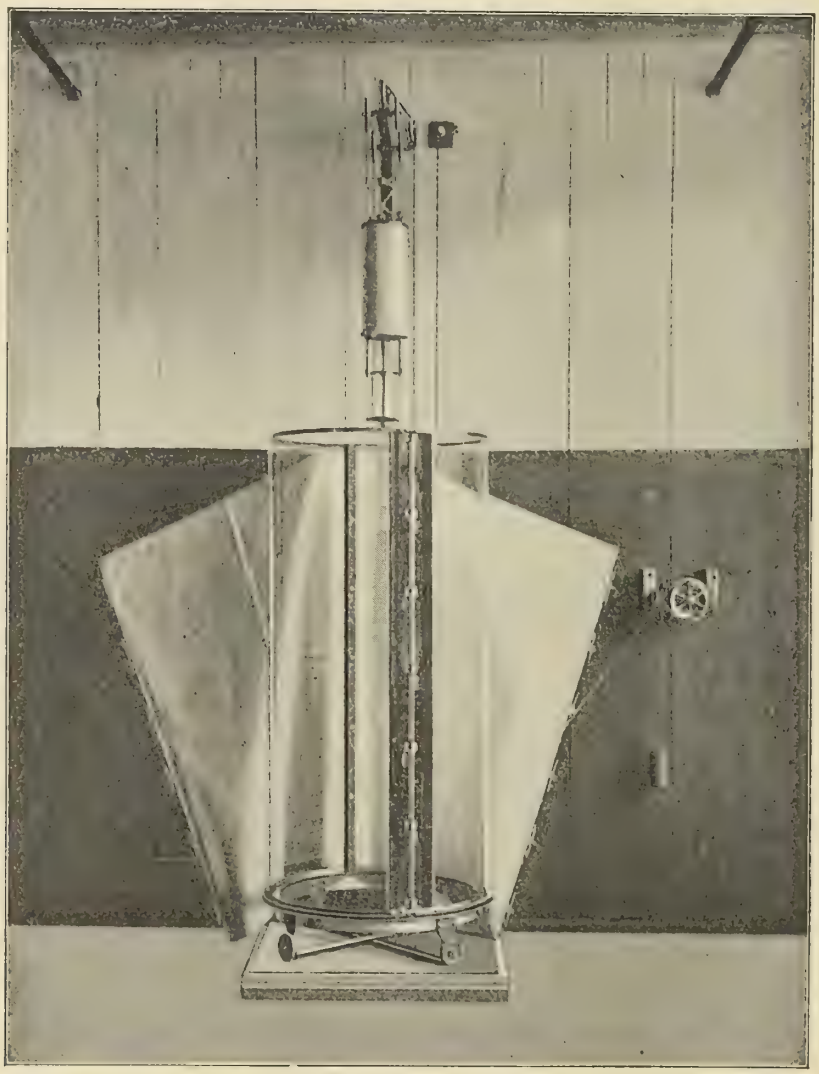
purposes must be supplemented by more reliable indicators, as for instance, on condensers where mercury column vacuum gauges are frequently used. By placing a high-temperature thermometer in the flue or uptakes from the boilers, the engineer can decide what position of the damper is the most efficient.

As most steamships of our day carry refrigerating and ice-making machinery, the temperature indicators are of no small importance in successfully operating this machinery, and here should be used thermometers for taking the temperature of the circulating brine in the freezing tanks, at the pumps, or in the distributing pipes. A special thermometer is made for indicating from the outside the temperature of the cooling chambers or cold storage rooms; and other forms of installment are used to determine the degree of cold in the hold of vessels engaged in the meat trade. An ingenious device lately perfected and used extensively in the United States Navy is a maximum and minimum thermometer for determining the very important matter of temperature in the magazines and coal bunkers.

For the above mentioned purposes, thermometers used must be accurate, practically constructed, and so attached to the various pieces of apparatus as to permit of making repairs at sea. All these points are covered by the goods manufactured by the Hohmann and Maurer Manufacturing Company, Rochester, N. Y., to whom further inquiries may be addressed.

Electric Blue Printing Machine.

The many disadvantages connected with blue-printing by sunlight are overcome in the cylindrical electrical copier made by the Pittsburg Blue Print Company, Pittsburg, Pa. This machine has been installed in large numbers throughout this country and abroad, and has given satisfaction wherever used.

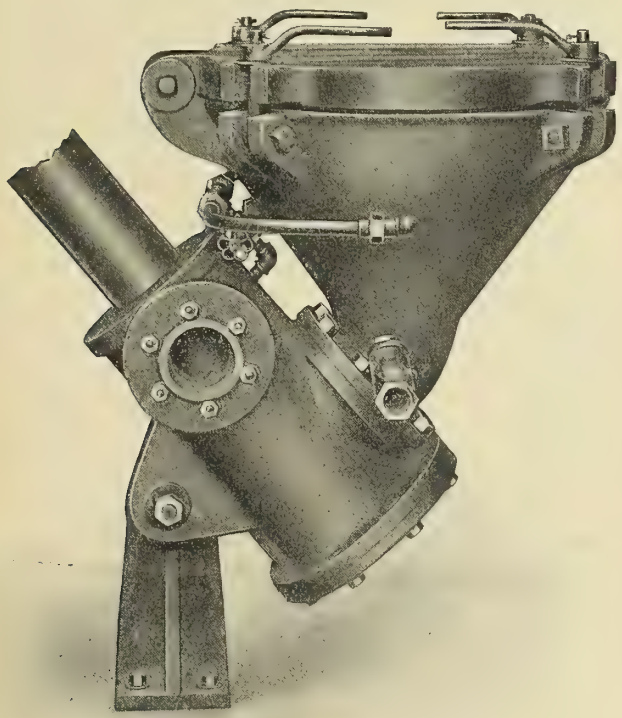


MACHINE FOR MAKING BLUE PRINTS BY ELECTRIC LIGHT.

The apparatus is made in convenient form so as to take up little room and to be of the best service in adverse conditions. The accompanying cut shows the general features of this machine. The glass cylinder is made of the best glass and the frame and angles are of wrought iron pipe. The tracing which is to be printed is wrapped around the cylinder, the

blue print paper placed over it, and then the adjustable covering which holds the two in close contact is fastened on. The electric lamp is of special design and so constructed as to give a uniform intensity of light. The lamp is lowered with uniform speed down through the cylinder and raised again, its operation being practically automatic, so that whatever attention is required can be entrusted to a boy.

The advantages of this machine are, that it does not depend upon the weather, and is thus absolutely independent of sunlight; the prints are of uniform color, and the saving of labor is very large.



A NEW ASH EJECTOR.

Hydraulic Ash Ejector.

The Davidson Ash Ejector has in the short time it has been on the market become greatly appreciated on account of its reliability in performing quickly and easily the hitherto very unpleasant job of disposing of a steamer's ashes.

It is built on scientific principles which overcome the objectionable features to be found in other machines designed for this purpose. The body of the ejector is set at the angle of inclination of overboard pipe, thus dispensing with one elbow or bend, and as the wear in this pipe is principally at the bends, this is important.

The hydraulic stream which operates the ejector enters on delivery end of ejector cylinder, striking a contracted nozzle which projects it through delivery pipe, drawing ashes, etc., from bottom portion of ejector cylinder to this point by vacuum created by the stream going overboard, with which the ashes mingle, and as they must pass through an orifice smaller in diameter than the overboard pipe before coming in contact with the hydraulic stream, it will be seen that the clogging of the pipe is impossible.

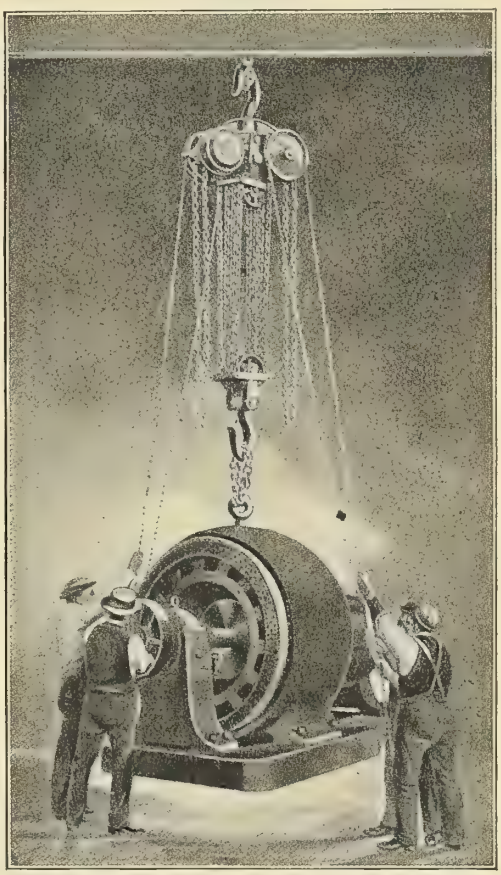
In case a clinker too large to pass through this opening should be thrown into the ejector, the stream will continue to pass overboard and not rise through hopper and flood the fire room, as in other ejectors, while the obstruction can be easily reached with a bar and broken up or removed.

The hopper is provided with two small jets which wet the ashes and wash them into the body of ejector.

These ejectors will operate with less water and at a lower pressure than any other.

At a trial of one of these ejectors, size 4 inches, with a 4½-inch discharge pipe, 4,000 pounds of ashes were discharged 14 feet above hopper and 8 feet from end of discharge pipe, in nine minutes and a half.

Further information, with prices and plans, will be cheerfully furnished by the manufacturer, M. T. Davidson, 141 Broadway, New York City.



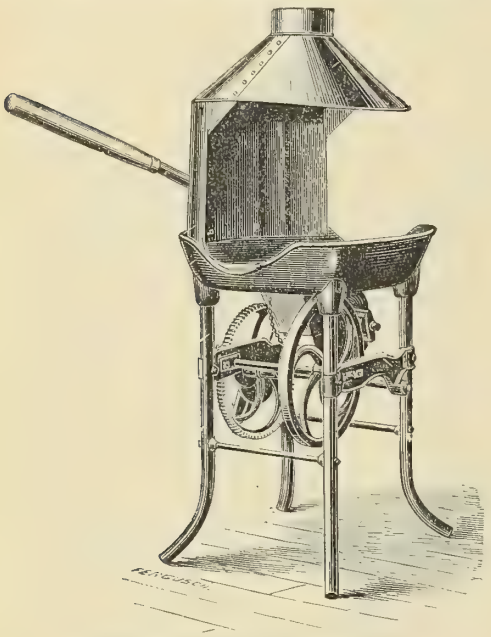
TRIPLEX CHAIN BLOCK FOR PORTABLE HOISTING.'

Quick Lifting for Heavy Work.

The problem of overcoming gravity in the handling of material has always been a knotty one, and heretofore the mechanic requiring a portable hoisting machine has been forced to content himself with appliances which waste in the friction of the moving parts

a considerable fraction of the power applied to the machine. In the Triplex Chain Block illustrated herewith, it is claimed that this loss is greatly reduced, owing to a transmission of the power through a balanced train of spur gears, with an independent automatic device for sustaining the load without wasting the operator's time and strength in hoisting against unnecessary friction. By this means an efficiency of nearly 80 per cent is claimed, marking a radical departure in this class of machines and making this the only block wherein the power to hold the load self-sustained at any point is not due to excessive friction which must be overcome in hoisting.

Twelve, sixteen and twenty ton sizes are made similar to the block shown in the illustration, with two independent hand chains arranged so that these loads may be lifted as fast as was formerly possible for a five-ton load with the screw or differential gear-



FORGE FOR OUT-DOOR SERVICE.

ing commonly used. The smaller sizes are made with a single hand chain in the usual manner, and their ease and speed in lifting, together with their rapid and easy lowering, make the Triplex Block a saver of half the time and two-thirds of the power necessary to accomplish the same work with other hand hoisting appliances. Wherever quick work is wanted and economy in time and labor is sought, this block is rapidly replacing the older types.

This block is made by the Yale and Towne Manufacturing Company, 9 Murray street, New York, who publish a complete catalogue giving full information in regard to all sizes and kinds of chain blocks.

Empire Forges.

Forges of various types to suit the many branches of iron working, are built by the Empire Forge Company, Troy, N. Y. They are made for light or heavy work, for use in machine or blacksmith shops or for out of door work in shipyards or in bridge work. They are heavy, strong and durable, have bronze bearings, and the blower is geared instead of belted, and therefore there is no back motion. The forge here illustrated is for ship or bridge work and is built with a hood. The legs are of wrought iron pipe, there is a swivel handle, and when desired an iron ring is placed around the tuyere. As the entire forge is of metal, it is specially adapted for out of door service.

Consolidation of German Shipyards. — Carl H. Ziez announces that the work of the firms of F. Schicau, Elbing and F. Schicau's shipyard in Danzig will henceforward be vested in the sole right of himself and wife and that the work of the former firms will be carried on in an unchanged manner.

Barges for Manila.—The steamship *Melbourne*, belonging to the Philippine Transportation and Construction Company, recently left New York for Manila with a general cargo and nineteen steam barges. These barges will be used as steam lighters in the harbor of Manila and elsewhere about the islands for transferring freight from ships to land.

New Yachts.—There are ten new yachts, eight of them to be propelled by steam and two by sail, now building at the works of the Gas Engine and Power Company and Chas. L. Seabury Company, Morris Heights. These yachts are expected to be in commission in this city and will make fine additions to the Atlantic fleets.

Liquid Fuel in the Navy.—The Secretary of the Navy has transmitted to Congress to be included in the naval appropriation bill, an estimate amounting to $20,000, for the purpose of investigating the best means of burning liquid fuel for naval purposes. Accompanying the estimate is an urgent request from Rear-Admiral Melville for granting the appropriation.

Lehigh University Scholarships.—The following scholarships at Lehigh University, South Bethlehem, Pa., will be opened to competition at the annual examinations of June, 1902, for the collegiate year of 1902-1903: Two in the classical course, one in the Latin-science course and five in the following courses at $150 each: Civil engineering, mechanical engineering, electrical engineering, mining engineering, metallurgy and chemistry. The scholarships will be renewed from year to year, provided the holders thereof are in full standing in all their studies.

Lloyds Statistical Tables for 1901.—The total addition of steam tonnage added to the register of the United Kingdom during the year 1901 has been 1,173,390 gross tons, and of sail vessels 45,203 gross tons. The gross deduction of steam tonnage amounts to 488,449 tons, and of sailing tonnage 159,119 tons. The tonnage transferred to foreigners during the year amounted to 346,747 tons, which is the lowest total record for this item since 1896. Germany and Italy have been the largest purchasers during the last year, acquiring, respectively, 57,636 and 52,040. The vessels on the register of the United Kingdom on December 31, 1901, were, approximately, 9,488 steam vessels of 12,501,885 gross tons, and 10,571 sailing vessels of 2,133,312 gross tons, making a total of 20,059 vessels of 14,635,197 gross tons.

THE PROFESSOR ON SHIPBOARD.

Story of an Attempt to Combine Theory With Practice.

BY C. A. MCALLISTER, FIRST ASSISTANT ENGINEER, R.C.S.

CHAPTER VIII.

When the Professor awoke on the following morning he thought he must be in Fairyland. It was quite early, and the usual morning breeze of the tropics was blowing in through the open windows. Looking out he could see the tall palms and cocoanut trees in the hotel grounds nodding in the breezes, and the air seemed to be permeated with the fragrance of tropical flowers. The birds were singing merrily, and, in fact, all nature seemed to be in a laughing humor. With such pleasant surroundings the Professor was loath to arise, so he remained in bed until about 8 o'clock, when a knock came at his door and he was informed that breakfast would soon be over. After partaking of a light breakfast, consisting of fresh fruit and eggs, he walked towards the wharf, feeling like a different man entirely, and contrasting his present surroundings and feelings with those of a few days before, when the ship was rolling and pitching in a gale of wind. Being somewhat of a philosopher, he soliloquized that, after all, pleasures are only matters of contrast. Had he been sleeping in a wide bed in a cool room for the whole week before he would not have had the feeling of exhilaration which he was then enjoying. He also concluded that the ratio of such mornings to the mornings of discomfort on shipboard was entirely too small to cause him to spend the remainder of his life going to sea.

Arriving at the wharf, he found the usual motley crowd which is always in evidence along the water front of a tropical seaport. Scantily dressed negroes of both sexes were lolling around; market men were vending their wares and a general air of confusion seemed to prevail. As soon as he stopped walking and looked out in the harbor he was surrounded by a dozen importuning boatmen, who all wanted to row him off to the ship. After considerable palavering he managed to make a bargain with one, and was soon comfortably seated in the stern of a small boat and was put on board the steamer.

After exchanging greetings with some of his fellow-passengers and with the ship's officers he decided that as he was feeling so well he would spend a part of the day in the engine and fire rooms. As he emerged from his state-room, clad in his overalls, he was accosted by the chief engineer, who asked if he was going to try it again below, at the same time cautioning him regarding the heat. He went on to tell the Professor that he had made arrangements with a shop on shore to have about fifteen new tubes put in the boiler which had been blown down, and that they would probably be in port until the following morning. This was cheering news, as the college man had some time before concluded that he wouldn't care if they stayed in that port for a month. As he went into the engine-room he found the first assistant and a gang of men hustling around, making adjustments and overhauling things generally. Much to his surprise he found that the engine-room was almost as warm as when the vessel was under way. It had never occurred to him that when the cylinders of a large engine become thoroughly heated it would take them such a long time to cool off.

Walking out to the fire-room, he found there a scene of confusion. The workmen from shore were busy removing the old tubes, and the din of hammering made it almost impossible to hear anything else. The second assistant was "bossing the job," and as the shore men were working by the hour the gestures he was making indicated that he was using some vigorous language in his efforts to get as much work out of them as possible. He took time, however, to nod to the Professor and beckon to him to come over to where he was standing. During a lull in the noise he informed him that while the old tubes were being cut out and replaced he was having the boiler given a thorough cleaning. Looking through one of the furnace doors he espied a man in the back connections vigorously brushing away at the surfaces and surrounded by a heavy pall of soot. This was a part of the duties of a fireman that the Professor had never witnessed before. As he was standing there a man crawled out of one of the wing furnaces to get a breath of fresh air. By a series of acrobatic motions he finally got out and stood up alongside of the Professor. The man's appearance almost horrified the sympathetic college man. He felt convinced that he was a white man, as there was none other in the crew, but from his present appearance he certainly looked like the blackest of negroes, and the Professor felt sure that his own mother would not have recognized him. His hair, which was naturally of a reddish tinge, was now as black as ink. His ears were almost filled up with soot. His skin was covered thick with a pasty-like substance composed of soot and perspiration, and his overalls, originally blue, were now as black as his shoes. In fact, the whites of his eyes and his teeth were the only visible parts which were not of inky blackness. In spite of his evident discomfiture, he smiled and nodded to the astonished college man as if he had casually met him on deck.

"Goodness gracious, my poor man, how in the world do you stand such work?"

"Oh!" said the fireman, "it's all in getting used to it, but, to tell you the truth, it isn't much fun, sir. I don't know but that I would rather clean the back connections than work inside," he continued. "Just look at Callahan in there," said he, pointing to one of the manhole openings.

The Professor looked through the opening, and by the flickering glare of a smoky hand lamp hung on one of the boiler braces he discerned the form of a man who was working away at cleaning the crown sheet of one of the furnaces with a wire brush. The man was simply wedged in between the furnace and the shell of the boiler, and just had sufficient room to work his arm. The Professor ventured a little closer and stuck his head inside the manhole. The sickly, warm vapor-like atmosphere inside the boiler soon caused him to withdraw his head and gasp for a breath of the pure air in the fireroom. His first impulse was to rush on deck and protest to his brother that it was nothing less than downright cruelty to compel men to work in such a place. While considering

this move his attention was attracted by a pair of shoes being thrust out of the manhole, which were soon followed by a man's legs, which, after being waved around in the fireroom, gradually elongated until after a final effort the whole of the man's body emerged from the narrow opening. The man proved to be Callahan, who, after drawing in a deep breath of cool air, smiled and said, "Good morning, sir; I thought I would come out and get a spell, as that is pretty hard work in there."

"Hard work!" said the Professor; "I don't see how you live, let alone do any work, in such an infernal place as that."

"Oh!" replied Callahan, "that isn't so bad; if we can get a whiff of fresh air occasionally and a few minutes' rest, I don't mind it so much."

The second assistant, overhearing the Professor's remarks, said to him:

"That's one part of the business that you don't learn in books, but it is something we practical men all have to go through with. I've done my share of it, and, in fact, I'll have to go all through this boiler today to see that these fellows have cleaned it properly."

The Professor said he was glad that he did not have to do it, "for," said he, "one day of that kind of work for me and there would be a vacancy in a certain college faculty that I know of."

"It isn't so bad as all that," replied the officer, "but it is something that has to be done, and we generally try to make the best of it."

Callahan had now finished his spell and crawled back through the manhole into the boiler, from which the faint sound of a man whistling could be heard as he resumed his work. The Professor again looked in and this time saw the fireman rubbing the crown sheet with a handful of old bagging. This, the assistant explained, was soaked in kerosene oil, and was for the purpose of removing such of the greasy deposits which had not been taken off by the wire brush.

"Isn't it dangerous to use kerosene oil around that old hand lamp?" inquired the Professor.

"Yes, I suppose so, but then the men have to be careful," said the engineer.

"What a horrible thing it would be if that man's oily clothing should catch fire in that cramped space," said the college man. "Why he would be literally roasted alive before he could get out."

"That is one of the pleasant things that goes with the job," said the assistant; "but how are you going to prevent such dangers?"

To this the Professor replied that he thought something ought to be done to make such work less dangerous and uncomfortable to the poor men who had it to do, and that he would try to think of some scheme to help them. Upon inquiry he learned from the engineer that there were six men cleaning the inside of the boiler, and that it would probably take them all day to complete the job. The interior had been found to be fairly clean, except for a thin coating of grease and scale on the heating surfaces and on the shell at the water line. When it got very dirty, he was informed that it was customary to boil it out with soda and concentrated lye and then give it a thorough blowing out through the surface blow.

The Professor said, "Of course you only clean by hand such portions of the heating surfaces as can be gotten at, but how do you clean the tubes which are inside of the outside rows?"

"We don't clean them at all," replied the assistant, "except what cleaning they get by the boiling-out process, and that, I find, does not remove the grease and scale from those tubes."

"As those tubes constitute more than three-fourths of the heating surface," said the Professor, "it seems to me that some attempt should be made to get at them for cleaning purposes."

"Well the only way that I know of is to cut them out and put in new tubes," replied the engineer.

As the Professor felt that he was in the way, and taking up too much of the engineer's time, he determined to go up on deck and to come down in the fireroom again after luncheon. After this function was over he called the subject of boiler cleaning to his brother's attention, and remarked that something ought to be done to make the work a little less irksome. To this the chief replied that he was ready for suggestions.

"Well," continued the theoretical brother, "I have thought the matter over, and my ideas may seen impractical to you, but, for one thing, I would not let a man go inside a boiler with one of those miserable hand lamps. You have steam on the boilers, and a dynamo that is not in use. You certainly ought to have a half-dozen portable hand lamps and sufficient insulated wire to reach to any part of the boiler. With electric lights the men would not be in danger of having their clothes catch fire, and they would not have to breath the horrible smoke from burning lard oil in the lamps. The air in a boiler recently blown down is certainly foul enough without the addition of so much of this sickly smoke."

"Another thing is, that you have a whole lot of electric fans on board here which are not now in use. What is to prevent you from connecting three or four of them up so as to blow fresh air into the lower manholes so as to create a current of air through the inside of the boiler and thus get rid of a great deal of that foul vapor that collects there? Of course I know that you may think these ideas are a little 'old maidish,' but I feel convinced that a few little attentions like these to the comfort of the workingmen would be more than compensated for by the increased amount of work that would be accomplished."

"I think that it is also possible to devise a rotary wire brush that could be operated by a small electric motor, and manipulated by a man inside of the boiler. In that way the crown sheets could be cleaned in a third of the time now taken up on cleaning them by hand. I also understand that an electric brush has recently been patented for cleaning in between the tubes, which cannot be gotten at by hand. This motor rests on a moving carriage which is slid along on top of the tubes, and which operates a long steel wire brush which is so shaped as to fit in between the adjacent rows of tubes in such a manner as to clean the entire surface."

The chief, after giving the suggestions considerable thought, remarked that he thought some of his

brother's ideas were good ones, and that the next time they cleaned a boiler he would try the electric lights and the fans.

"It won't cost anything to speak of, and it might do some good."

The Professor sat around under the awnings watching the unloading of freight, until about four in the afternoon, when he decided to take another look into the fireroom. It was still quite warm down below, as there was very little breeze blowing, and consequently but little air was driven down the ventilators. Much to his surprise he found that all of the damaged tubes had been drawn out, and over half of the new ones had been put in their places. He took occasion to examine some of the old tubes which had been cut out, and found that most of them had leaked on account of pits, which had eaten clear through the metal.

He found upon inquiry that but little of the old zincs were found inside of the boiler when it was opened up, which satisfied him that the damage to the tubes was occasioned by neglect in looking after the zincs. Although no baskets were to be had for holding the new zincs, at that time, he was much pleased to learn that the second assistant had put in a liberal amount of new zinc plates, and that they had been connected to the braces in the manner that he had described. The second assistant inquired of him as to how much zinc he thought ought to be put in the boiler. To this the Professor replied that it was very hard to tell, as it depended largely upon experience. He suggested, however, that it would not be far out of the way if they used about a ratio of five pounds of zinc for each square foot of grate surface in the boiler.

The men had finished cleaning the interior of the boiler and had gone on deck to wash up. The manhole plates had been replaced and everything was in readiness to start fires as soon as the boiler-makers finished putting in the remainder of the new tubes. As it was impossible to do this before eight o'clock in the evening, the Professor decided that he would spend another evening on shore. As he walked through the engine room on his way up he could not help noticing how neat and clean everything looked when contrasted to the appearance of things on the previous day. The floor plates had been thoroughly cleaned, and all the brass work about the engine was shining. Seated on a box in a corner was Barney, with his face buried in his hands. Upon being asked if he was ill, the oiler replied, "No, sir, I'm not exactly sick, but I'm on the *sthool* of *repintance*. I wint ashore lasht night and drank a whole lot of that dago booze they have here, and my head has felt as if there was a wather hammer in it all day."

The Professor smiled and said that it must have been an alcohol hammer he had felt.

"You know, Barney," said he, "that the best way to stop a water hammer is to shut down on the throttle, so the best way for you to prevent these headaches is to throttle your thirst when you go ashore."

"Right you are, sir!" groaned poor old Barney.

After a few expressions of sympathy for the oiler, the kind-hearted Professor went to his stateroom and prepared to spend another evening on shore before the ship sailed.

TECHNICAL PUBLICATIONS.

LIGHT, HEAT AND POWER IN BUILDINGS. By Alton D. Adams, Member American Institute of Electrical Engineers. One 12mo. vol., cloth; 102 pp. Price, $1. New York: W. T. Comstock.

This book is intended for the architect and building engineer. It is intended to be practical rather than theoretical, and to present in compact and convenient form the main facts relating to the various sources available for light, heat and power in buildings. Questions of economy and efficiency occupy chief attention, and the purpose is to aid in the intelligent selection of the means best suited to the special ends in view. Special attention has been given to setting down, side by side, the costs of service from different sources, thus making comparisons simple and direct.

The general purposes of the book seem to have been carried out with good judgment and care. Questions of cost, of special adaptability, of relative desirability, etc., must often contain a considerable personal element, and while the author is free to give in his opinion the points for and against various systems, it is done in a manner with which none can find fault, though one might not always agree with his conclusions.

The book is well written, contains in convenient form a large amount of valuable information, and may be recommended to all who are interested in the problems with which it deals.

Novel Method of Raising a Wreck.—An unusual method was used in raising the wreck of the bark *Arthur*, which foundered in Boston Deeps, Lincolnshire, during the heavy gales of the present winter. The decks and the inner structure of the ship were removed, leaving only the frame and sides, and during high water a steamer was floated over the wreck and allowed to subside inside the hull, the wreck was then made secure to the deck of the steamer, and upon the following tide was lifted off the bottom and towed to a higher portion of the shore, where the work of breaking up could be carried on at low water.

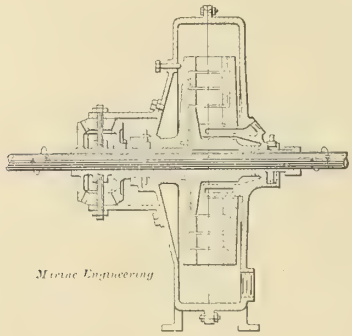
SELECTED MARINE PATENTS.

693,855. APPARATUS FOR PREVENTING COLLISIONS AT SEA. NICHOLAS GHERASSIMOFF, ST. PETERSBURG, RUSSIA.

CLAIM.—The combination with a ship, of a feeler, consisting of an electrically-propelled buoyant body connected with said ship, collision and depth indicating appliances connected with said body, and electrically-operated collision and shoal-water indicator on board ship, controlled by the aforesaid collision and depth indicating appliances, an electric circuit including said appliances and indicator and means for supplying current to the feeler-propeller from aboard ship, for the purpose set forth

2. The combination with a ship, of a feeler, consisting of an electrically-propelled submerged buoyant body, a float connected with said body, an electrically-operated visible signal carried by said float, collision and depth indicating appliances likewise connected with the body, a collision and shoal-water indicator on board ship controlled by said appliances, an electric circuit including said signal, the collision and depth indicating appliances and the collision and shoal-water indicator, and means for supporting current to the feeler-propeller, for the purpose set forth. Twenty claims.

693,946. TURBINE ENGINE. HIRAM H. BOYCE, CHICAGO, ILL.



CLAIM.—1. In a turbine, the combination of a frame; a pair of wheels journaled on a common axis in said frame and revoluble in opposite directions; a series of blade-rings disposed between said wheels and secured alternately to opposite wheels, each of said blade-wheels comprising an annular series of blades disposed at an angle to the radial direction, the blades on one wheel being disposed oppositely to those on the other; one of said wheels having an annular recess on side of same; a hollow ring seated in said recess, secured to said frame and having in its outer periphery an opening through which a stream of fluid may be caused to flow against said blades, thereby causing said wheels to revolve in opposite directions, a considerable portion of the periphery of said ring being without opening so that the supply of fluid will be cut off from each of the blades of the inner series during a considerable part of each revolution. Two claims.

694,153. MEANS FOR AUTOMATICALLY BALLASTING SUBMARINE BOATS.

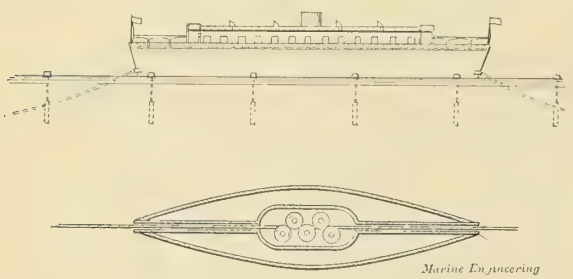
694,154. SUBMARINE BOAT OR VESSEL. JOHN P. HOLLAND, NEWARK, N. J.

694,274. BUOYANT PROPELLER. BERNEDOTT T. HEROLD, VALLEJO, CAL.

694,355. CONVEYING APPARATUS. JAMES G. DELANEY, NEW YORK, N. Y., AND THOMAS S. MILLER, SOUTH ORANGE, N. J.

CLAIM 1.—In combination, two relatively moving supports, a load-carrier, a ropeway whereon said load-carrier is transferred from one support to the other, a tension mechanism tending to hold said ropeway taut and consisting of a float immersed in a fluid. Six claims.

694,433. MEANS FOR GUIDING AND PROPELLING STEAMSHIPS. LOUIS SHER, ATLANTIC CITY, N. J.

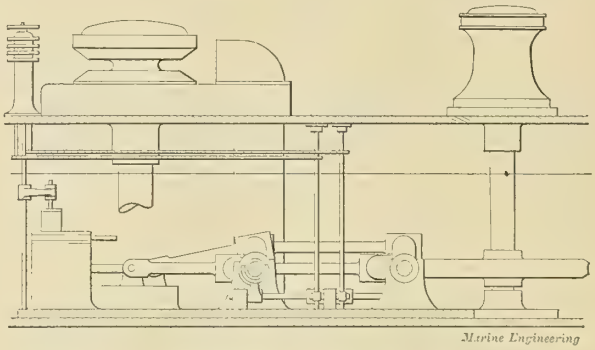


CLAIM 1.—In an apparatus of the character described, a cable extending from one terminus of a steamship-line to the other and secured rigidly to the shore at each end, said cable adapted to pass longitudinally through a vessel and be acted upon by friction-wheels, thereby furnishing a frictional surface for the propulsion of the vessel, a supporting-framework running parallel with the cable from one terminus to the other and lying at a level in the water below the keel of the vessel, buoys connected to said framework at predetermined intervals, anchors connected to said framework at predetermined intervals, substantially as and for the purpose set forth. Three claims.

694,468. RUDDER ATTACHMENT. EUGENE G. GAILLAC, JONESPORT, ME.

CLAIM 1. The combination with the stern of a boat, of a strip countersunk into the stern-post and secured thereto, integral inclined flanges on the sides and lower end of said strip, the latter tapering at its lower end, a bar having inclined sides and lower end and tapering at its lower end, hooks or loops on said bar, brackets bent around said hooks or loops and secured to the sides of the rudder. Two claims.

694,616. MECHANISM FOR OPERATING SHIP WINDLASSES AND CAPSTANS. FREDERICK N. CONNET, PROVIDENCE, R. I.



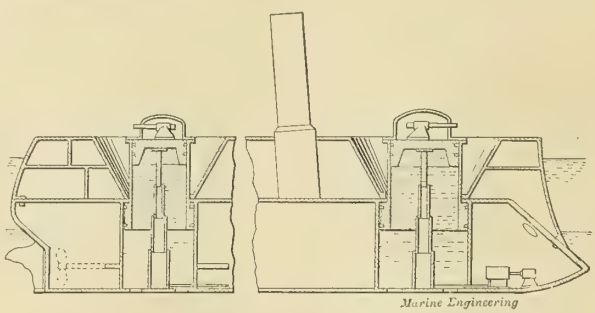
CLAIM 1.—In mechanism for operating ship windlasses and capstans, the combination of two shafts each containing two cranks at right angles to one another, two connecting-rods one between each of the cranks of one shaft and the corresponding crank of the other shaft, means for driving one of the shafts, a clutch between each capstan and windlass and one of the shafts, a standard, a hand-wheel for each clutch upon and surrounding the standard and having an interior gear, a rod for each wheel within the standard, a pinion upon each rod extending through the standard and meshing with the gear of its wheel, and connections between each of the rods and one of the clutches so that the latter may be operated by the rotation of the former. Four claims.

694,643. SUBMARINE BOAT. JOHN P. HOLLAND, NEWARK, N. J.

694,980. ELASTIC-FLUID TURBINE. HERBERT McCORNACK, LITTLE FALLS, N. Y.

695,108. WAR VESSEL. HUDSON MAXIM, LONDON, ENGLAND.

CLAIM 1.—In a vessel the combination of the main hull, a flotation superstructure secured water-tight upon the main hull, ballast-cylinders formed in the main hull and communicating with the open sea, pistons working in said ballast-cylinders, and power devices for operating said pistons, whereby the main hull may be maintained at the sea level or depressed below the same as desired.



2. In a vessel the combination of the main hull provided with a protective deck, a cellular flotation superstructure secured water-tight upon the main hull, fixed ballast-cylinders formed in the main hull and communicating with the open sea, movable cylinders playing in said fixed cylinders and in open communication therewith, weighted pistons playing in said movable cylinders, and a power device controlling the movements of said pistons. Ten claims.

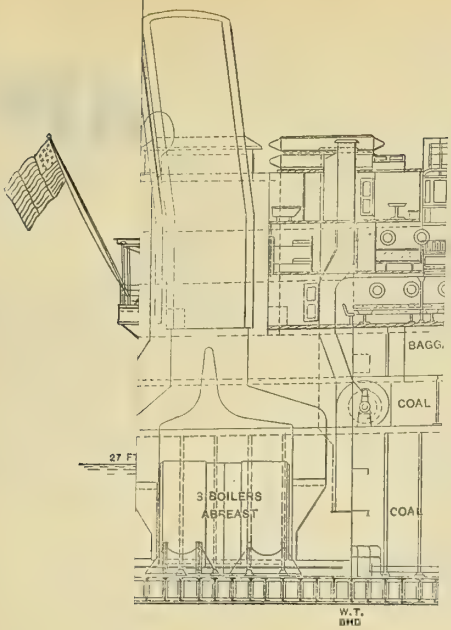
695,215. SUBMARINE BOAT. SIMON LAKE, BRIDGEPORT, CONN.

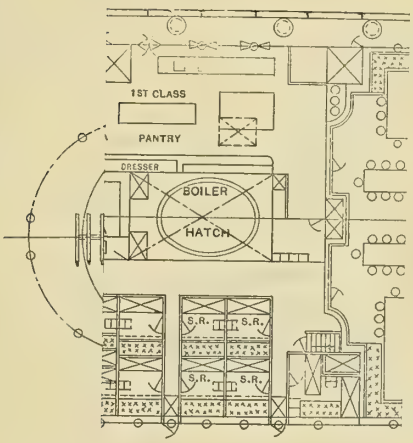
695,276. MARINE PROPELLER. BURRELL CANNON, PITTSBURG, TEX.

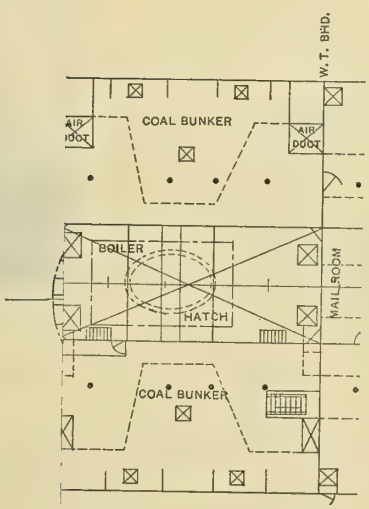
CLAIM 1.—In a propeller or motor-wheel, the centrally pivoted blades, and an eccentric revoluble feathering-wheel arranged to detachably engage the end portions of said blades, and adjustable to vary or reverse the action of said blades, substantially as specified. Fourteen claims.

695,389. PROPELLER-WHEEL. LEANDER W. HAMMOND, PLAINFIELD, N. J., ASSIGNOR OF ONE-HALF TO SAMUEL A. WALLACE, NORTH PLAINFIELD, N. J.

CLAIM.—In a propeller, the combination of a hub coned off at both ends and having diagonal grooves therein, and blades mounted on said hub, substantially as described.

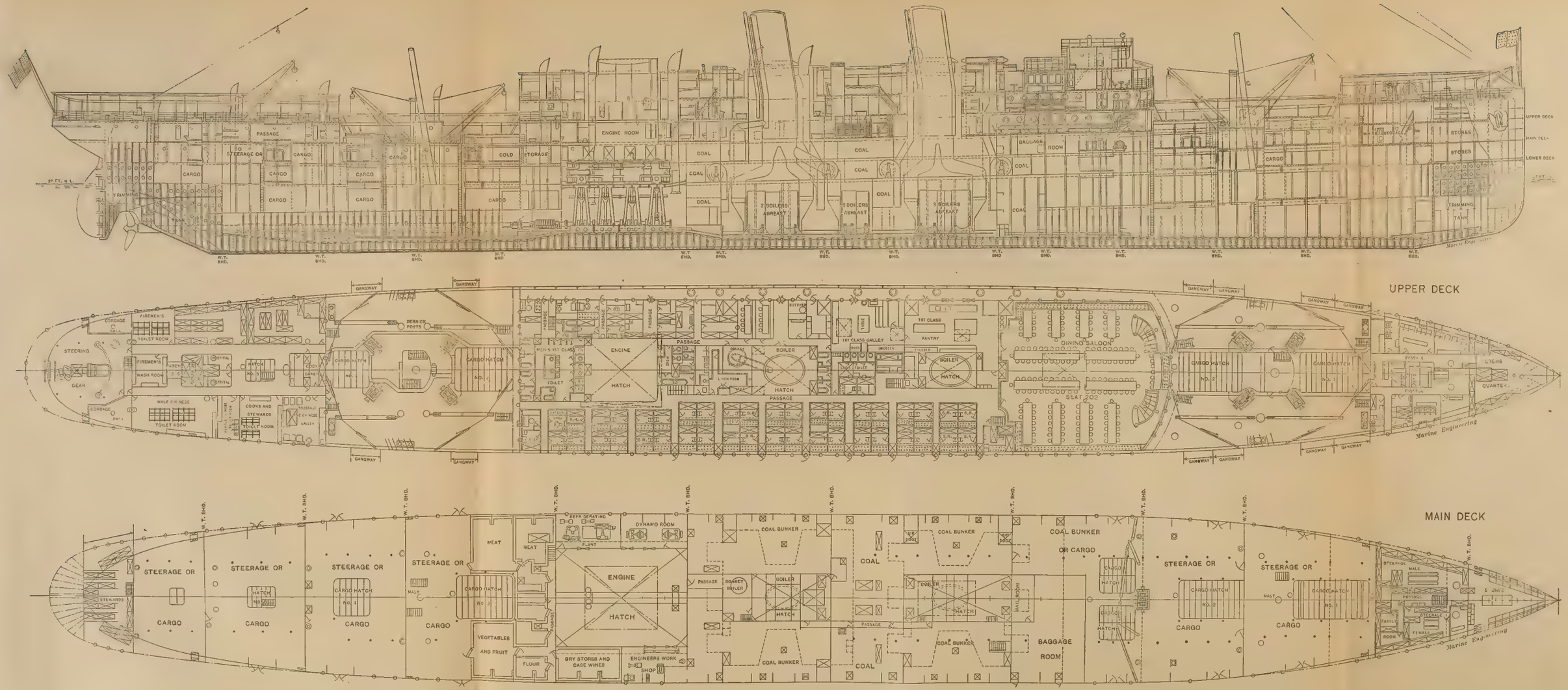






ND DRY DOCK COMPANY

SUPP



LONGITUDINAL ELEVATION AND DECK PLANS OF THE TWO SHIPS BUILT BY THE NEWPORT NEWS SHIPBUILDING AND DRY DOCK COMPANY FOR THE PACIFIC MAIL STEAMSHIP COMPANY.

LONGITUDINAL ELEVATION

Marine Engineering

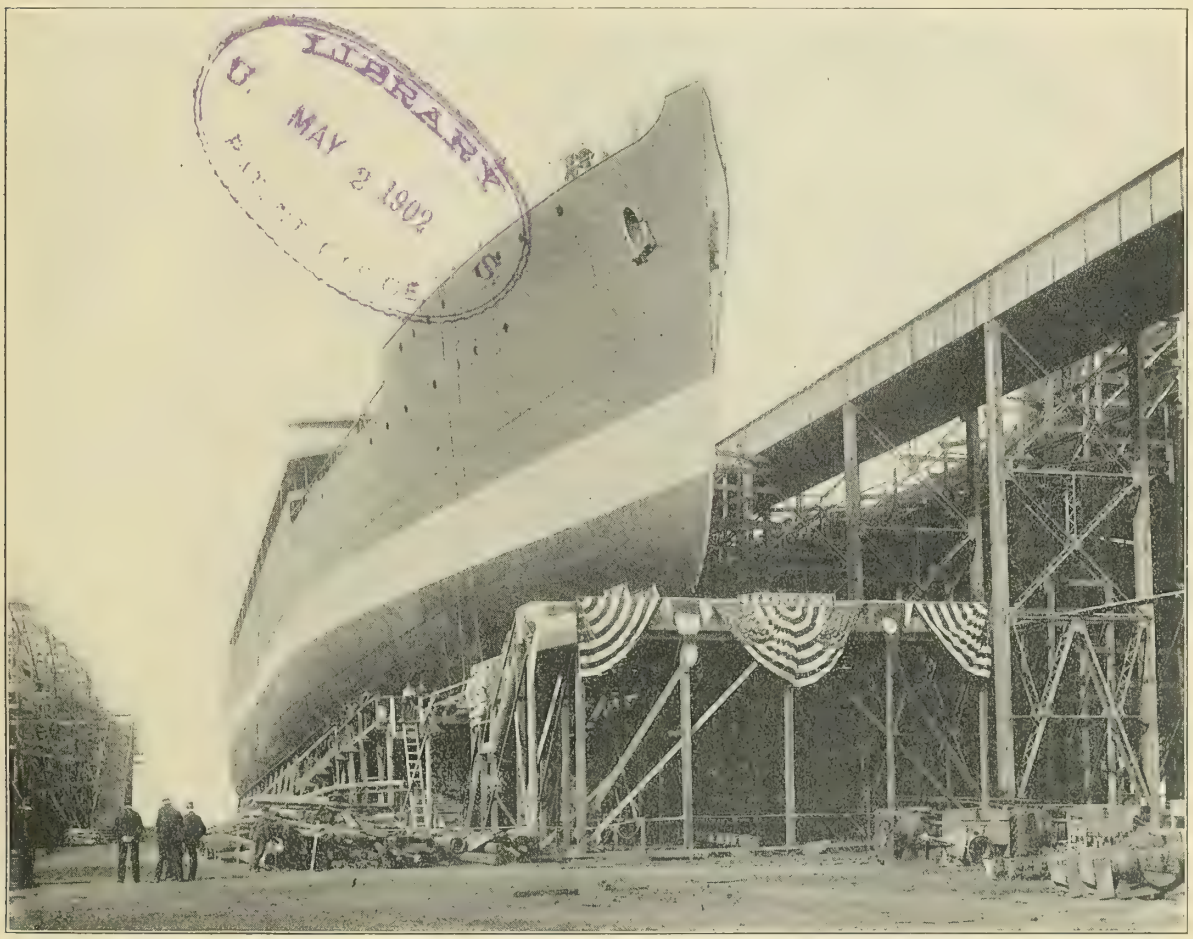
Vol. 7. NEW YORK, MAY, 1902. No. 5.

PACIFIC MAIL STEAMSHIPS KOREA AND SIBERIA, BUILT BY THE NEWPORT NEWS SHIPBUILDING AND DRY DOCK CO.

The largest ship yet built in America is just reaching completion at Newport News, Va. This is the twin-screw steamship *Korea*, one of two sister ships built by the Newport News Shipbuilding and Dry Dock Company for the Pacific Mail Steamship Company to ply between San Francisco and Japanese and Chinese ports.

These ships are the first of their size to reach completion in this country, although the rapid progress of the shipbuilding industry in America is attested by the fact that these ships had not been launched before some of a trifle larger dimensions had been laid down at other places. While the *Korea* and *Siberia* do not surpass the *St. Louis* and *St. Paul*, built at Cramp's, in speed and passenger accommodation, yet they do surpass the former ships considerably in their dimensions, in freight carrying capacity and in tonnage and displacement.

The *Korea* is 550 feet long between perpendiculars, 63 feet molded beam. The principal dimensions are given in the table at the end of the article, and, of course, all particulars mentioned will apply equally to the *Siberia*, which is but a few months behind her in state of condition.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STEAMSHIP KOREA READY FOR LAUNCHING FROM THE YARD OF THE NEWPORT NEWS SHIPBUILDING AND DRY DOCK COMPANY.

There are three complete decks, four tiers of beams, and promenade deck. The length and tonnage of deck erections are as follows: Poop, 92 feet, 347 tons; bridge, 245 feet, 1077 tons; forecastle, 72 feet, 148 tons. The gross tonnage is estimated at 11,300, and the net at 7,285 tons.

The ships are classified in the Bureau Veritas and

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the American Bureau of Shipping, and conform in all particulars, outfit, etc., to the United States Steamboat Inspection Rules.

The principal scantlings are as follows:

Inner keel, 46 1-2 inches wide, of 32-pound plate.

Outer keel, 60 inches wide, of 36-pound plate.

Rubbing strip, 13 inches wide, of 32-pound plate.

Longitudinal keel angles, 6 by 6 inch by 21.9 pounds. Main frames, 6 by 3 1-2 inch by 15.3 pound angles spaced uniformly 32 inch centers and all running to upper poop and forecastle decks. The reverse frames are 5 by 3 1-2 inch by 13.6 pound angles running to upper deck on every frame, and to forecastle deck on alternate frames. The web frames are 32 inches deep. The deck beams are 9 by 3 1-2 inch by 21.8 pound bulb angles on all main frames. Other scantlings may be seen by reference to the accompanying plan of the midship section.

The outside plating is run in fourteen strakes to upper deck, 32 pounds amidships, tapering to 28 pounds at the ends, except for the upper deck sheer strake which is 36 pounds tapering to 30 pounds with a doubling worked amidships. The next strake below is also doubled.

The stem is a steel casting, as is also the stern post. The latter carries on its forward side the steel struts for propeller bossing. The rudder is of cast steel in one piece, with a wrought stock attached by means of a palm with bolted and keyed connection. The stock is 16 1-4 inches diameter and there are 6 steel pintles 6 1-2 inches diameter with brass bushings. The entire weight of the rudder is carried, not on the pintles, but on a bearing in the upper deck.

The ships are designed to have a large cargo-carrying capacity and also a large list of passengers. At the same time the length of the sea trip makes necessary an unusually large coal capacity, and in order that the ships may when necessary sail light, an ample capacity for water ballast is provided. The water ballast is carried in a double bottom, which extends almost the entire length of the ship, from frame 16 to frame 175, a distance of 424 feet. Water ballast is also carried in the peak tanks and in a deep tank just forward of the cross coal bunker, and used either for water ballast or cargo. The capacities of these tanks in salt water are given in the table.

The double bottom extends amidships from the center vertical keel, which is water tight from frame 45 to frame 160 except at the wells, to the sixth longitudinal, which is well up the bilge.

It is 6 feet deep under the engines and 4 feet deep for the greatest length amidships. The margin varies from 40 inches deep amidships to about 32 inches aft. The flat keelson plate runs from 36 pounds to 22 pounds, and the rest of the tank top from 30 to 22 pounds, with heavier plates under the engines and boilers. The margin is 24 pounds throughout. The character of the inner bottom and its great extent forward are well shown in the accompanying photograph of the ship in frame.

The ship is divided transversely by 10 complete water tight bulkheads to the upper deck and 6 to the main deck, making 16 in all, of plate from 22 to 14 pounds, well stiffened by angle bulls 3 1-2 by 9 inches by 21.8 pounds. There is also a water tight center line bulkhead in the engine room running to the main deck, and thus placing the engines in separate water tight compartments.

The cargo and coal capacities are both large, as mentioned above, and are well illustrated, together with their relative distribution, in the following summary:

SUMMARY OF CARGO AND COAL CAPACITIES.

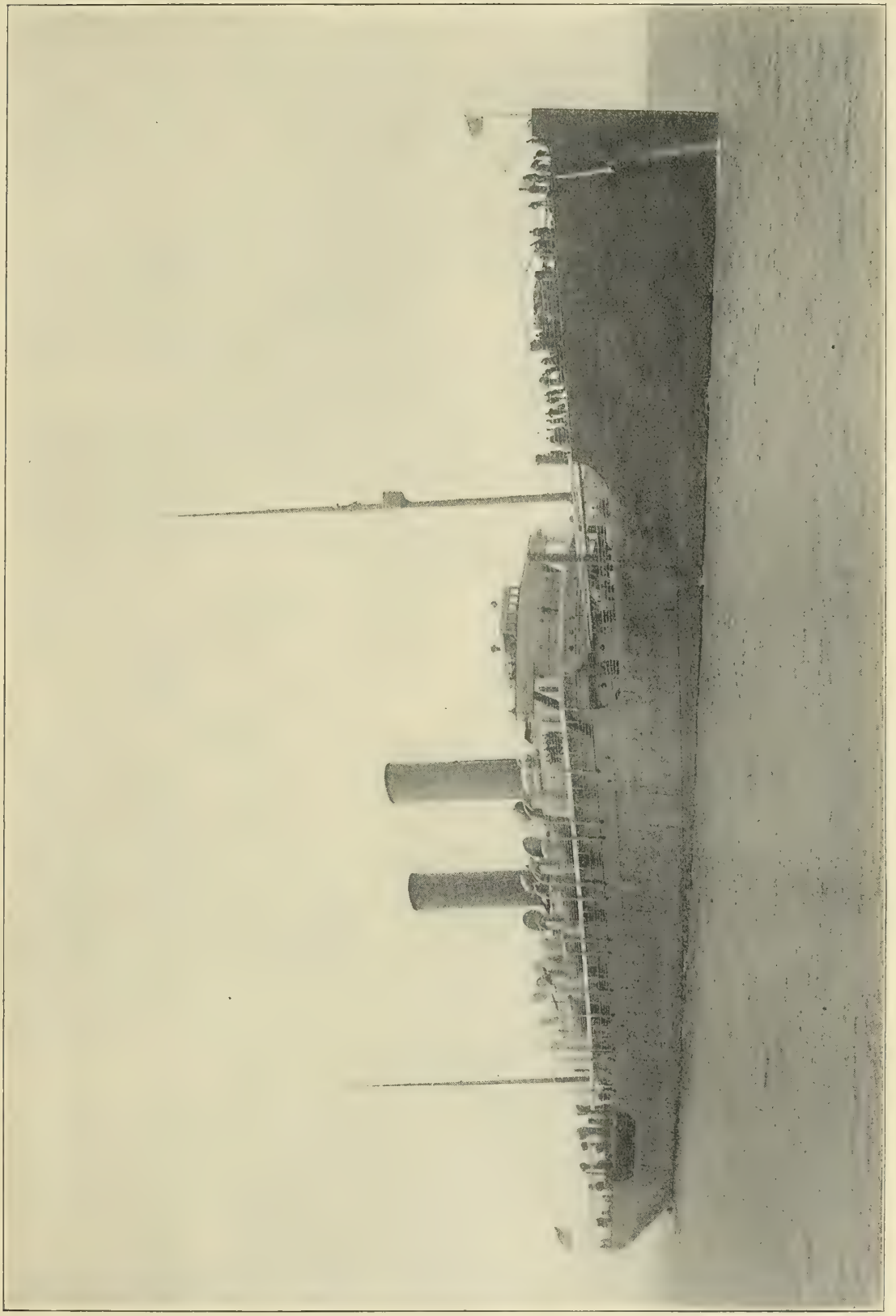
Space.	Coal, cu. ft.	Cargo, cu. ft.
Bunkers 8, 11, 12 and 13	55,321	64,055
" 1 to 7 and 9 and 10	103,320	
Cargo spaces only		397,146
Stores		13 849
Deep tank (water or cargo)		18,403
Baggage Room		7,990
Cold Storage Rooms		9,023
Total available cargo and corresponding coal	103,320 or 2,583 tons	510.466
Total available coal and corresponding cargo	158,641 or 3,966 tons	446,411

Four of the coal bunkers are arranged so as to be used for either coal or cargo; the deep tank can be used for cargo or water ballast; and the spaces fore and aft on the main deck are arranged to be used for cargo or steerage. Thus the distribution of spaces is rendered very elastic and the ship is prepared to meet almost any condition of loading.

The propelling machinery consists of two four-cylinder, vertical inverted, quadruple expansion engines with cylinders 35, 50, 70 and 100 inches diameter and 66 inches stroke. They were designed for 86 revolutions per minute and 17,500 I. H. P., and this was expected to drive the ship 18 knots per hour sustained speed.

The piston rods are 8 inches diameter for all cylinders and the connecting rods 8 1-2 inches diameter at the center and 138 inches long. The crank shaft is 19 1-2 inches diameter with a 6-inch hole. The thrust shaft is 19 inches, the line shaft 18 3-4 inches, and the propeller shaft 19 1-2 inches, all with the same sized hole. There are 14 thrust collars 31 inches diameter by 2 1-2 inches thick, with a 4-inch space between. The bed plate and bushings are of cast steel throughout. There are 8 cross girders 3 feet 8 1-2 inches deep at the center under the recess for bearing boxes, and 2 feet 11 inches deep at the side. All cylinders are provided with piston valves of 10 inches travel and the following characteristics: H. P., one 20-inch valve inside steam. First M. P., two 17-inch valves outside steam. Second M. P., two 28-inch valves inside steam. L. P., four 25-inch valves outside steam. The main steam pipe is 13 inches diameter and the exhaust to the condenser consists of two 24-inch pipes. The valve motion is the ordinary Stephenson double bar link type, with a reverse shaft 9 inches diameter, and 20 inch steam and 9-inch hydraulic reversing cylinders. The turning engine is a 7 by 7 by 5 inch double engine with the usual worm wheel drive.

Each main condenser has 11,787 square feet of cooling surface and the two auxiliary condensers 600 square feet each. There are four centrifugal main circulating



STEAMSHIP KOREA OF THE PACIFIC MAIL STEAMSHIP COMPANY.

pumps with a capacity of 6,080 gallons per minute each. The suction and discharge pipes are each 14 inches diameter and the engines are compound 11 inches and 20 inches by 10-inch stroke.

The other auxiliaries are as follows:

Main air and circulating pumps, two Blake vertical compound, 12 and 20 inches steam, 24 inches and 24 inches air by 18-inch stroke.

Auxiliary air and circulating pumps, two Blake horizontal simplex, 10 inches steam, 12 inches and 12 inches air and 12 inches stroke.

Main feed pumps, four 16 by 12 5-8 by 18-inch Blake vertical simplex.

Fire and bilge pumps, two 10 by 9 by 12-inch Blake duplex piston.

Ballast pumps, two 8 by 16 by 12 by 18-inch Blake vertical simplex compound.

Fire and ballast pump, in fire room, one 10 by 8 by 12-inch Blake vertical simplex.

Sanitary pump, one 8 by 7 by 12-inch Blake horizontal piston duplex.

Sanitary pump, one 8 by 12 by 12 by 12-inch Blake compound horizontal duplex.

Hot well pump, one 8 by 12 by 18-inch Blake vertical simplex.

Evaporator feed pump, two 6 by 6 by 8-inch Blake vertical simplex.

Distiller fresh water, one 6 by 6 by 8-inch Blake vertical simplex.

Combined fresh and salt water to distiller, two 4 1-2 by 3 by 3 by 4-inch Blake vertical simplex.

The propellers are 19 feet 6 inches diameter, 25 feet pitch, and with three detachable blades. The hubs are cast steel and the blades are manganese bronze.

The steam generating plant consists of six double end and two single end Scotch boilers and one vertical donkey boiler. The main boilers are arranged in two compartments. Three double end and two single end are in the after compartment, and three double end in the forward compartment. All are arranged with axes fore and aft, and with athwartship fire rooms at each end of the double end boilers, one being between the double and single end.

The double end boilers are 16 feet 0 inches mean diameter and 20 feet 3 inches long. Each has 6,416 square feet of heating surface and 153 square feet of grate surface. There are eight 40-inch corrugated furnaces, and 1,152 2 1-2-inch tubes. The single end boilers are 16 feet 0 inches mean diameter and 10 feet 5 1-4 inches long, with 3,208 square feet of heating, 76 square feet of grate surface, four 40-inch corrugated furnaces and 576 2 1-2-inch tubes. The donkey boiler is on the main deck and is a vertical tubular boiler 6 feet 0 inches diameter and 11 feet 7 inches high over all, with 541 square feet of heating and 21 square feet of grate surface. The steam pressure for all boilers is 200 pounds.

There are two stacks, one over each set of boilers. The stacks are elliptical, the forward one 11 feet 3 inches by 7 feet 9 inches inside and 13 feet 9 1-2 inches by 10 feet 3 1-2 inches outside, and the after one the same outside and 12 feet 9 inches by 9 feet 3 inches inside. Both are 108 feet high above the grates.

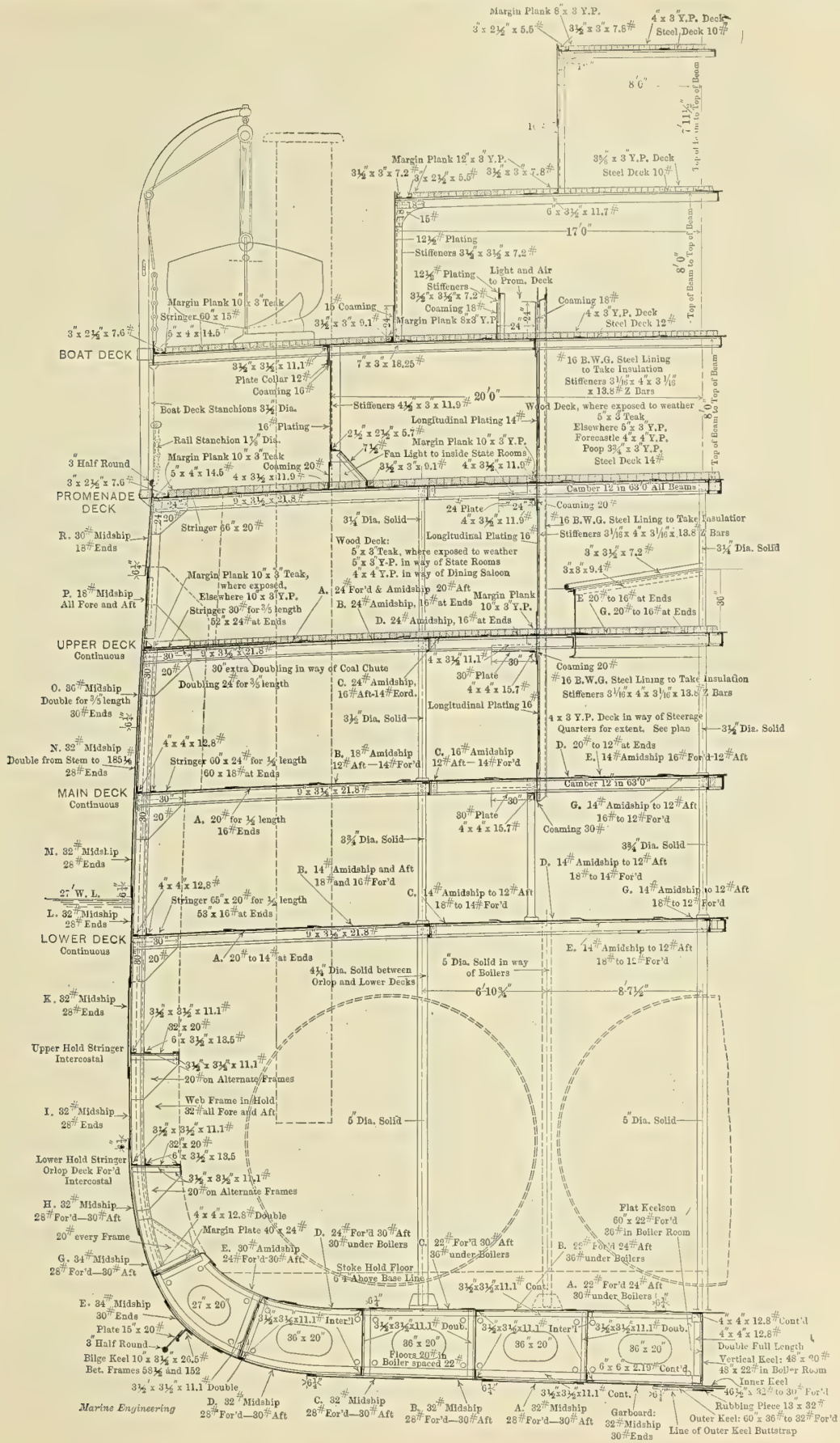
The ship is provided with forced draft on the closed stokehold system and the air is heated by means of air heaters in the uptakes, before it passes into the furnaces. There are thirteen 60-inch blowers with 19-inch tips. Each is run by a separate direct-connected 5 by 4-inch double engine. The length of engine room is 48 feet, after boiler room 58 feet 4 inches, and the forward boiler room is 40 feet.

The steering arrangements on the bridge are expected to be especially satisfactory. There is a chart and wheel house on the bridge deck above the captain's and officers' quarters and with a companionway leading from these quarters up into the chart room. In front of the chart room is the wheel house, containing only the wheel and a compass with a card of the exceptional size of 12 inches diameter. Immediately in front of the wheel house on the open bridge is a glass screen framed in steel. Behind this screen are located the engine telegraphs, steering telegraphs, docking telegraphs, whistle operators, etc. On each side the athwartship bridge extends to the side of the ship with a steel bulwark on the forward side, capped by a teak rail.

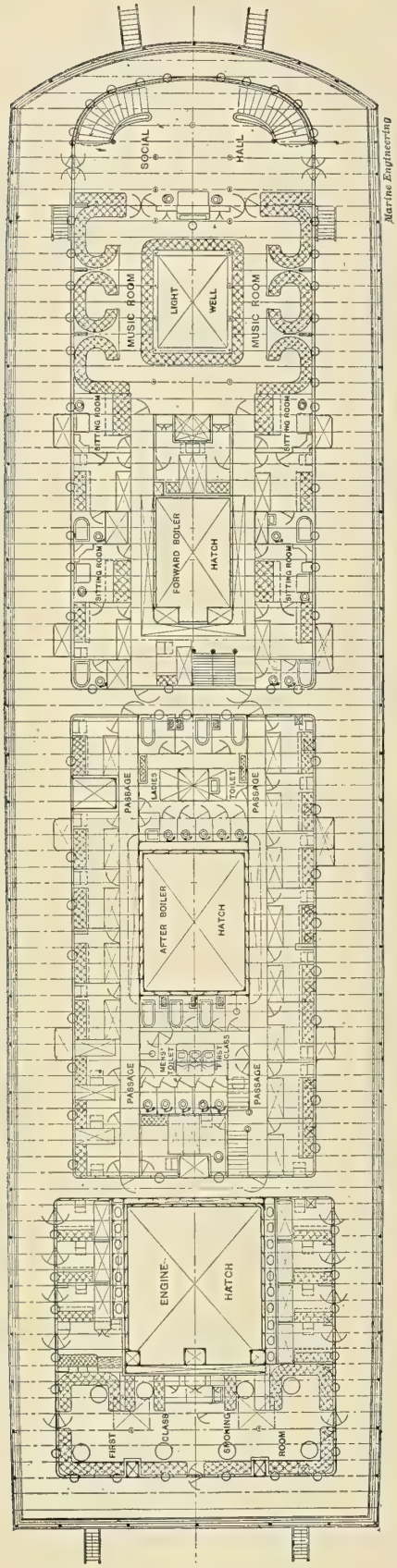
On top of the chart and wheel house is a Lord Kelvin standard compass and a Rushmore searchlight. An electric automatic device is also provided for blowing the whistle automatically at stated intervals during a fog. There is a complete telephone system for officers' communication.

The steering engine is located in the steering gear room aft on the upper deck, and is controlled from the forward station by means of a Brown hydraulic telemotor. The steering gear is of the "Brown Steam Tiller" type, and both steering gear and telemotors were furnished by the Hyde Windlass Company. The steering engine is carried on the tiller and moves around with it. The engine drives, through an expanding clutch, a worm, which in turn drives a worm wheel and a pinion, both on the same vertical shaft mounted in the end of the tiller. The pinion meshes into a rack segment bolted to the deck. The engine receives and exhausts steam through a double stuffing box on the axis of the rudder head. Two oil pumps provide ample lubrication for the whole apparatus. The steering valve is operated by a lever which is brought back to mid position as the tiller moves around. This lever is connected to the after telemotor cylinder. The telemotor can be controlled from a small hand wheel in the steering gear room, or from the hand wheel in wheel house on forward bridge. The gear is generally similar to that used on the *Campania, Lucania, Kaiser Wilhelm der Grosse, St. Paul* and others.

There is also a hand gear consisting of three hand wheels aft of the rudder head, driving through worm and wheel, a pinion which meshes into a segment secured to the rudder stock. There is also a way of operating the tiller by means of the port steam warping capstan on the poop deck. This is done by extending the capstan shaft down into the steering gear room. A chain wheel is fitted at its bottom, and a chain led from this wheel around sheaves in the end of the segment on deck and then attached to each side of the tiller. Thus the ship may be steered by power from the wheel house on forward bridge, from the steering gear room, or by means of the steam capstan on the



MIDSHIP SECTION OF THE STEAMSHIP KOREA.



PROMENADE DECK, STEAMSHIP KOREA.

poop, and by hand from the steering gear room. A telltale compass with 7-inch card is provided in the steering gear room for that purpose.

For cargo handling there are five hatches on the open decks, two in each well and one on the poop. Besides these there are six cargo ports on each side of the ship opening into the main deck space. Two of these give access to two blind hatches under the dining saloon. In the forward well are two derrick posts each fitted with two booms capable of handling seven tons each. In the after well there are four posts and four booms as above. In each well there are four winches 8 inch by 8 inch double reversible, each provided with a wire rope drum and with two winch heads, and capable of exerting a pull of 5,000 pounds on one head. The posts in the forward well are also supplied with guys and fittings so that a boom capable of lifting 30 tons may be rigged over the after hatch, and a special boom is carried for this purpose. Arrangements are made for lifting this immense load in order to enable the ship to load and unload heavy mining machinery, armor plate, etc., which it is anticipated will be carried to China and Japan. On the poop deck are two other derrick posts and booms capable of handling two tons each and one winch similar to the above to operate them. Over the blind hatches in main deck, under the dining saloon, are two hatch cranes of two tons capacity each, with one winch similar to the above, except with double drum, to operate them. All winches are furnished by the Hyde Windlass Company. Besides the above there is a small 6 by 6 inch double winch with three heads, located on top of house on boat deck abaft the forward stack, which is used exclusively for handling life-boats.

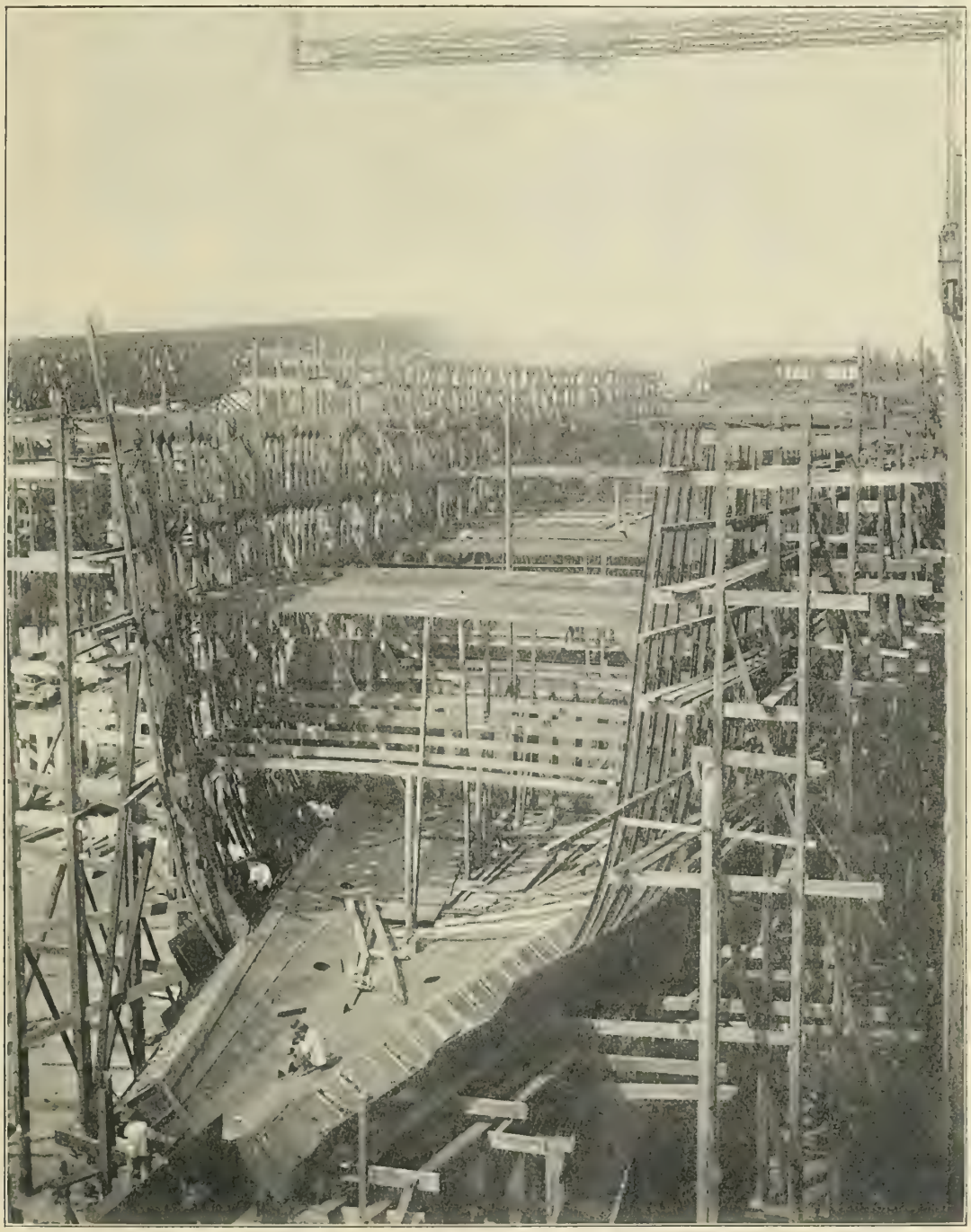
The anchor handling and the warping appliances consist of a two-cylinder reversible 16 by 14-inch windlass in the open on the forecastle deck, and two steam warping capstans on the poop. The windlass is fitted with two wildcats for handling 3-inch stud link chain cable, and with two "nigger heads." It is also arranged to operate the three warping capstans on the forecastle. There are three bower anchors, one weighing 15,680 pounds and two 12,320 pounds each. All are of the Dunn stockless type.

On the poop deck aft there is a Lord Kelvin sounding machine for taking soundings over the stern at any depth and any speed of the ship.

One of the most interesting and complete installations on the ship is the refrigerating plant. It is on a very large scale even for this class of vessel, and is provided with the idea of carrying cargo in cold storage as well as with the idea of furnishing the passengers with all the luxuries and delicacies that cold storage makes possible. The plant was furnished by the Vulcan Iron Works, of San Francisco, Cal. It consists of two special steamship 8-ton refrigerating machines, each consisting of compound steam engines and compound ammonia compressers. Brine tank and cooling coils are provided equal to the capacity of one of the above machines. The machines are cross connected so that they may be operated independently, or both together. They are in duplicate so as to have one machine at least always ready to operate on the system, and to provide for a future increase if desired.

The brine coils cool about 1,321 square feet of floor space, shown aft of the engine room on the main deck, and at the same time make 1,200 pounds of ice every 24 hours in blocks of 70 pounds each, and cool the water in two 15-gallon drinking water coolers.

insulated from the ship's structure, the walls being filled with mineral wool. The refrigerating machines are in a room abreast the engine room on the main deck and just abaft the dynamo room. The ammonia condensing coils are in the bedplates of the machines,



SHOWING THE WATER BOTTOM AND BOW FRAMING OF THE SIBERIA.

The refrigerated space is divided into rooms for meat, vegetables and fruit, butter and eggs, flour, dry stores and wines, etc., all provided with appropriate fittings, hooks and shelving. All spaces are thoroughly

and circulating water is pumped through from the sea by independent pumps in the same room.

Just forward, as mentioned above, are two 35 K. W. generating sets consisting of 6 pole dynamo, 318 am-

peres at 400 r. p. m. and tandem compound 7 1-2 by 12 1-2 by 6-inch direct connected engines. This plant furnishes current for 820 lights throughout the ship, for the search light and for the two ventilation blowers for passengers' quarters. One machine is capable of taking care of the ordinary service required, so that there is always opportunity for overhauling the other and there is plenty of reserve power if required. The generating sets were furnished by the General Electric Company.

Directly across the ship from the dynamo room is an engineers' work-shop containing one 16-inch swing lathe 12 feet 6 inches between centers, one 25-inch drill press, one small drill press, one 16-inch shaper, a pipe threading machine, emery wheel, grind stone and vice bench. Power is supplied by a 7 by 7 inch independent engine driving through line shafting and belting.

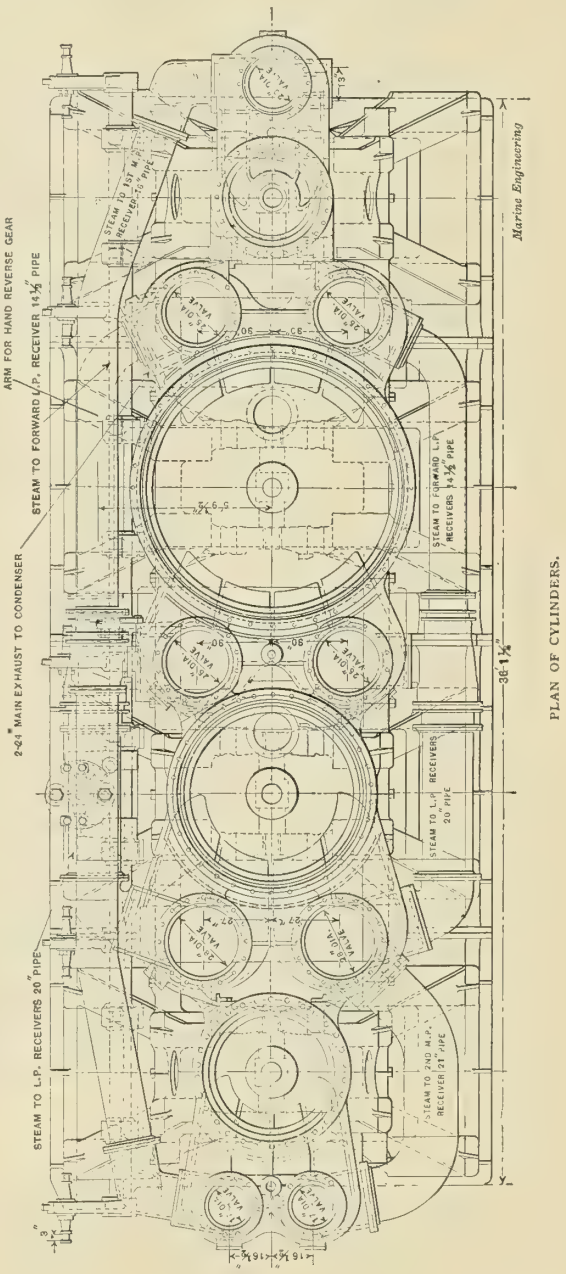
The accommodations for passengers and crew are confined entirely to the boat, promenade, upper and main decks, where there are provided quarters for 200 first-class passengers, 60 white steerage, 1,200 Chinese steerage and 236 crew.

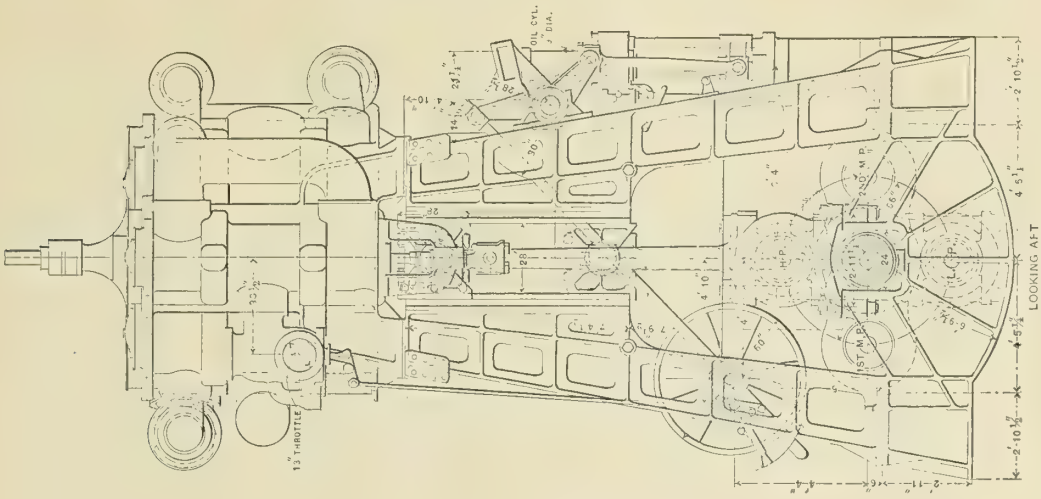
On the boat deck forward is a house devoted almost exclusively to officers' quarters, with a companion leading directly up into the chart room, as described in another place. The captain is provided with a stateroom and a cabin occupying the entire front of the house, and with an outlook ahead and on both sides of the vessel. The stateroom has fixed bedstead and wardrobe, and the cabin a table, upholstered transom, roll-top desk, mahogany leather cushioned chairs, etc. There are staterooms for 9 officers besides the captain, and separate bath rooms and water closets for the captain and for the officers.

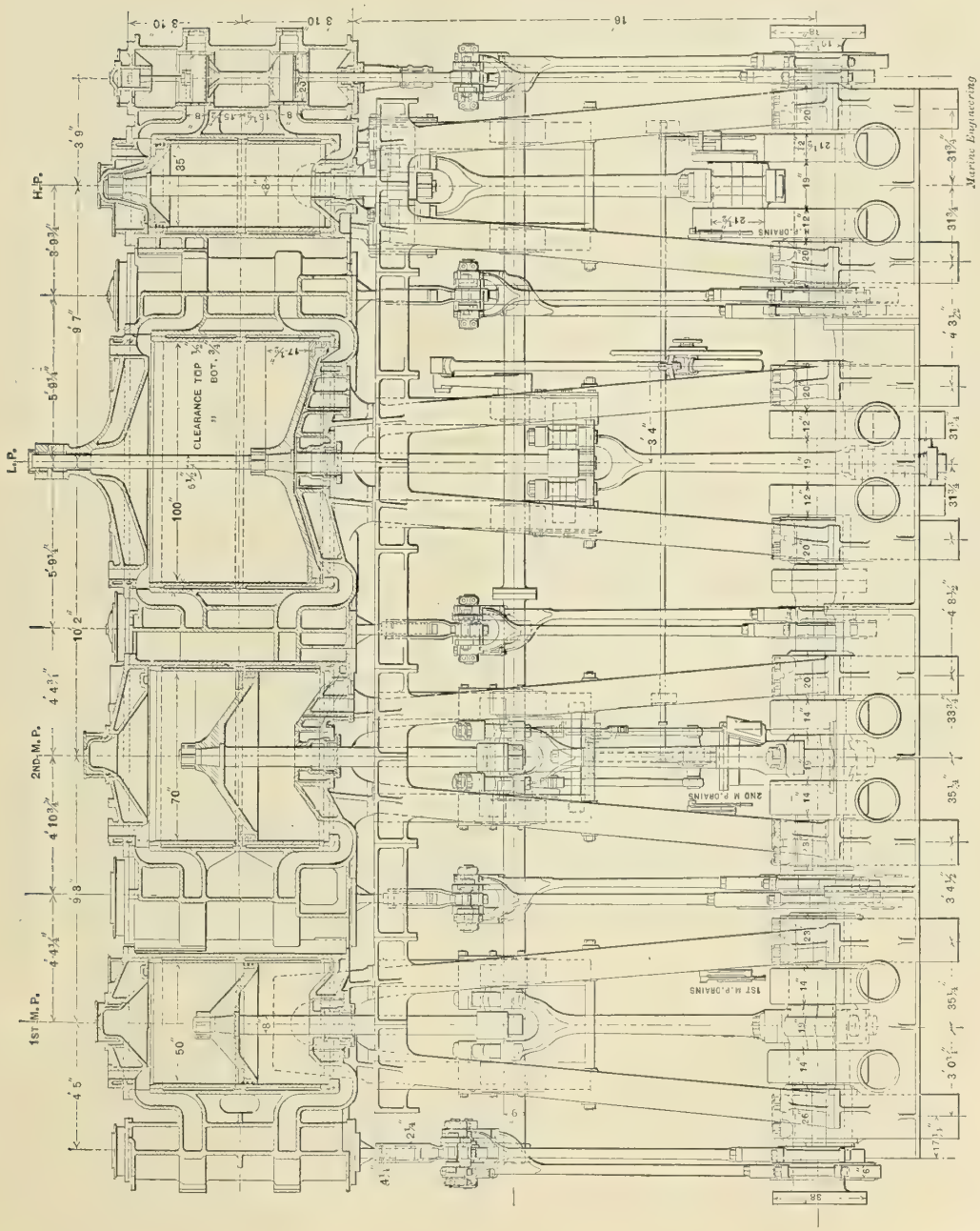
The bulk of the first-class passengers' staterooms are on the promenade and the upper decks. The upper deck is so arranged that the passenger quarters are all on the starboard side; and the galleys, pantries and quarters for the servants and crew, together with entrances to boiler and engine rooms, are all on the port side, with no passage across the ship. All along the port side from well to well there runs a working passage which provides all necessary communication for servants and crew and enables all the service of the ship to be performed without intruding upon the first-class passenger quarters. This arrangement is rather odd, in that it gives the ship a distinctly different appearance when viewed from port and from starboard, but it possesses many excellent qualities in the way of increased working facilities and minimum annoyance to passengers.

The first-class staterooms are all paneled in white, with dark cherry trimmings. Each is provided with a white enameled iron bedstead, brass fittings, upper and lower berths. There is in each room also a transom seat capable of being pulled out and converted into a berth, and a folding lavatory stand with porcelain and cut glass fittings.

On the promenade deck forward, and with an outlook forward and on both sides of the ship, is the social hall, floored in slate and white rubber tile, upholstered in red plush, and the walls ornamented with panels in staff work above a mahogany wainscoting. In this room also are provided two double mahogany writing desks, with all accessories, for the use of passengers. Between the social hall and the music room, which is just abaft of it, are double swinging doors with small panes of bevel plate glass. Leading from the social hall to the dining saloon below, is a double stairway of solid bronze with ornamental railings and newel posts. The dining saloon seats 202 people and is finished entirely in olive green, white and gold. The carpet is olive green, the upholstering is plush of the same color and the panels of the walls are ornamented and tinted in light green, ivory and gold. In the center of the saloon is a light well to the music room above, and thence through a trunk to a skylight dome on the bridge deck. The decks at this well are supported on fluted columns with ornamental capitals. The trunk is ornamented with lincrusta panels showing


Marine Engineering
ARM FOR HAND REVERSE GEAR
STEAM TO FORWARD L.P. RECEIVER 14½" PIPE
2-24" MAIN EXHAUST TO CONDENSER
STEAM TO L.P. RECEIVERS 20" PIPE
STEAM TO FORWARD L.P. RECEIVERS 14½" PIPE
STEAM TO L.P. RECEIVERS 20" PIPE
STEAM TO 2ND M.P. RECEIVER 21" PIPE
36 1½"
PLAN OF CYLINDERS.





FOUR CYLINDER QUADRUPLE EXPANSION ENGINE FOR THE KOREA.
Marine Engineering

NAME—Korea. NATIONALITY—American. TYPE—Ocean Passenger and Freight Steamship

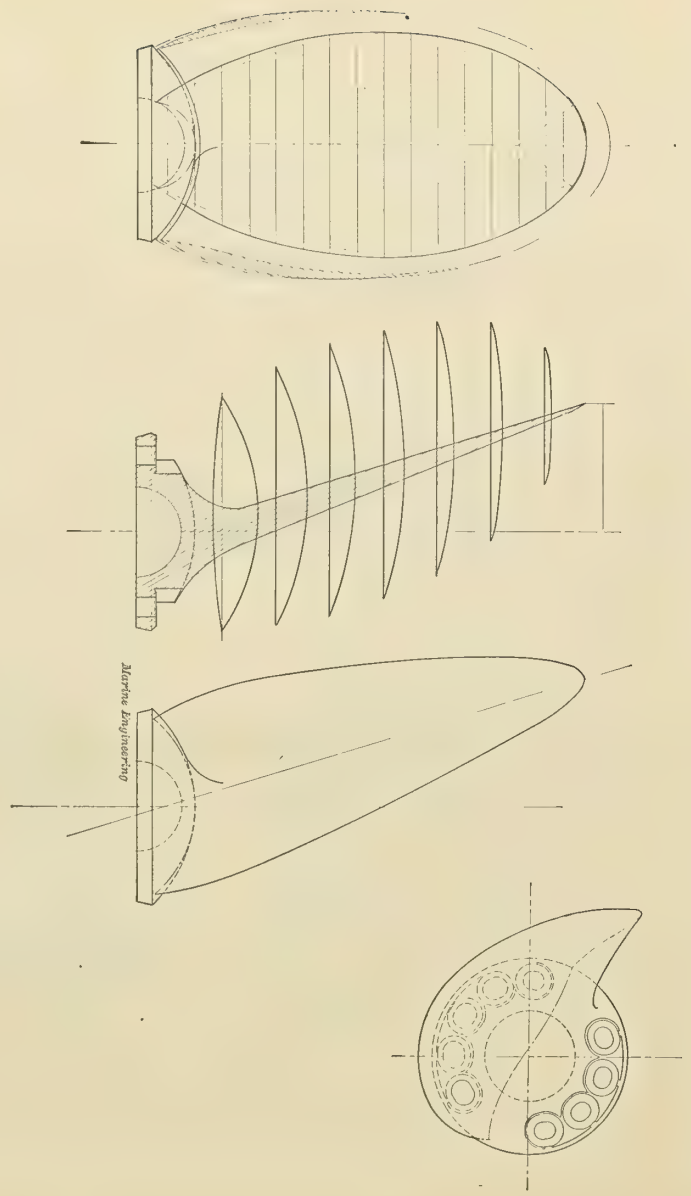
LAUNCHED—1901. BUILDER—Newport News S. & D. D. Co. OWNER—Pacific Mail Co.

Length over all	572 ft. 4 in.
Length between perps	550 ft.
Breadth, molded	63 ft.
Depth at side, mid length	40 ft. 10 in.
Depth at side, lowest point of sheer	40 ft.
Depth at center	41 ft. 10 in.
Block, coeff	.69
Prismatic, coeff	.72
Midship section, coeff	.96
Load draft	27 ft.
Load displacement	18,400 tons
Wetted surface	57,000 sq. ft.
Cargo capacity	510,466 cu. ft.
Coal bunkers	2,583 tons
Tanks:—	
Forward peak	225 tons
After peak	271 tons
Water bottom	2,124 tons
Deep well	526 tons
Propellers, number blades	3 each
Diameter	19 ft. 6 in.
Pitch	25 ft.
Material, Manganese bronze, cast steel hubs	
a, developed, each	101.4 sq. ft.

NAME—Korea. NATIONALITY—American. TYPE—Ocean Passenger and Freight Steamship

LAUNCHED—1901. BUILDER—Newport News S. & D. D. Co. OWNER—Pacific Mail Co.

Engines, number	2
Type	Quadruple 4 cylinder 4 crank
Cylinder diameters	35, 50, 70, 100 in.
Stroke	66 in.
I. H. P., trial	17,900
R. P. M., trial	89
Speed trial at load draft	20 knots
Condens. surf, two main	23,574 sq. ft.
Valves	All piston
Boilers, number	2 single, 6 double-end
Type	Scotch
Pressure	200 lbs.
Length, single end	10 ft. 5 1-4 in.
Length, double-end	20 ft. 3 in.
Diameter	16 ft.
Furnaces in each end	4
Furnace diameter	40 in.
G. S. total of boilers	1,070 sq. ft.
H. S. total of boilers	45,912 sq. ft.
Draft	Closed stoke hold
H. S. ÷ G. S.	42.91
H. S. ÷ I. H. P., trial	2.56
I. H. P. ÷ G. S., trial	16.91
Height of stack above grates	108 ft.
Donkey Boiler	Vertical tubular
Size	6 ft. diam. by 11 ft. 7 in high

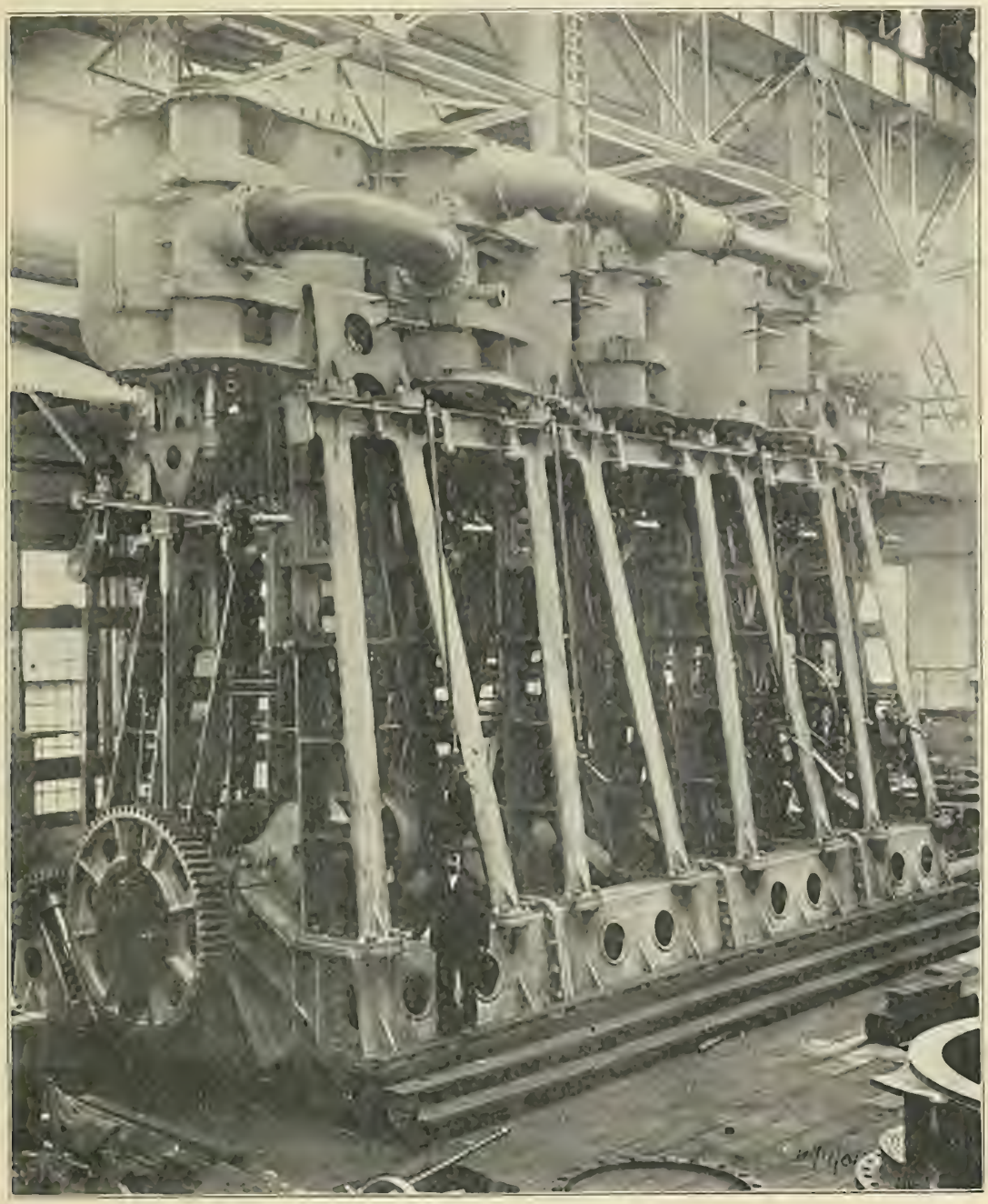


PROPELLER BLADE OF THE KOREA.

Marine Engineering

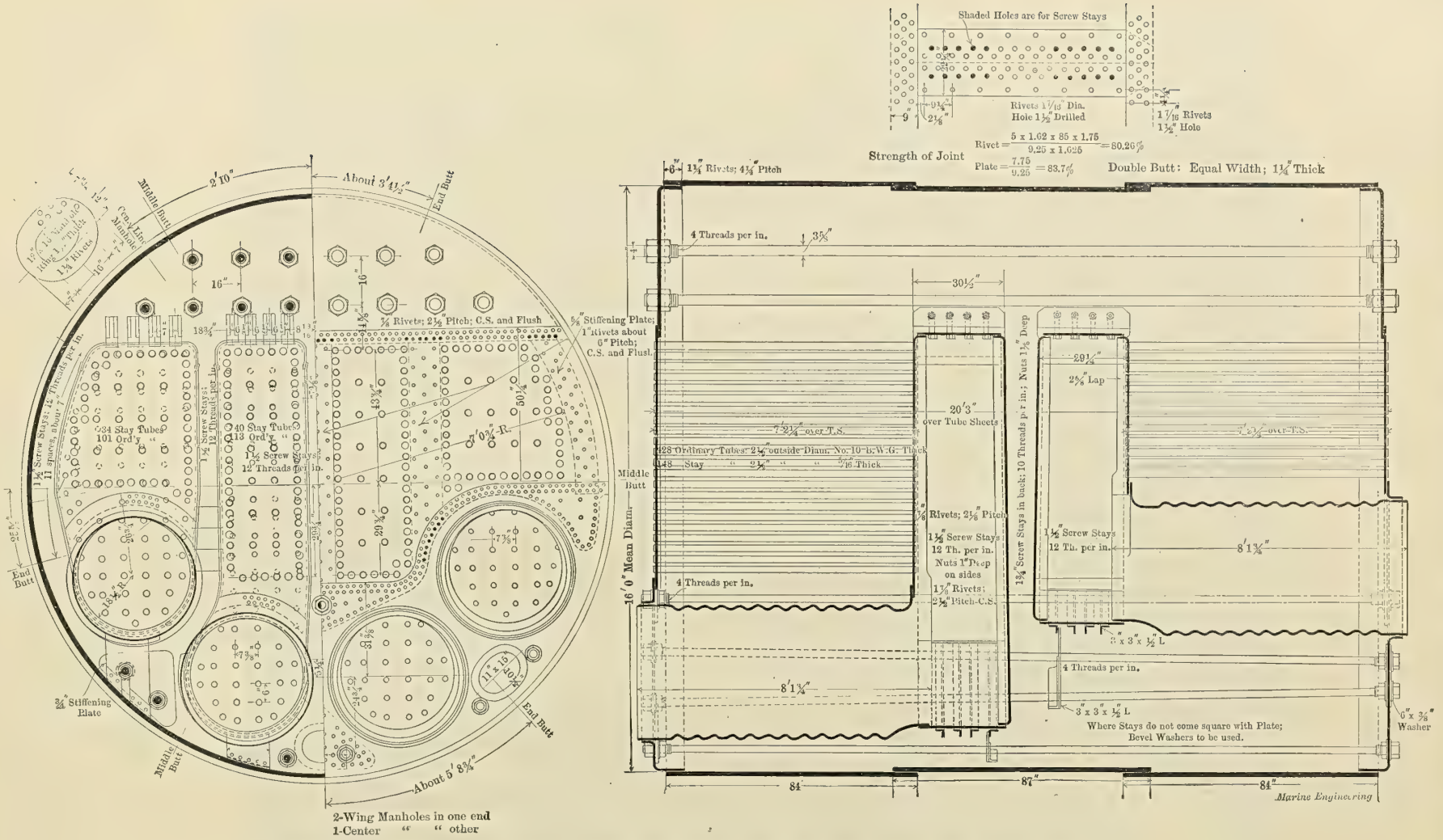
figures in bas-relief, tinted as described, and the arched skylight above is worked in leaded glass of a conventional floral design in olive green set in an opalescent ground. At night the skylight is illuminated from above with electric lights, the well is lighted with electricity, and lights are set in the ceiling panels of the dining saloon, the whole giving an exceedingly pleasing effect.

The music room, just abaft the social hall, is divided around the sides into numerous booths with a transom running around the inside of each, so that a number of parties may each obtain a considerable privacy. The whole is carpeted in red and upholstered in dark red plush. The woodwork is mahogany and the staff panels are tinted in light colors to harmonize with the general rich red effect. The light well described above passes through the center of the music room and may be looked into from this point. It is surrounded by an upholstered seat in red plush, and the bases of the fluted columns land on the broad top rail of this seat.



QUADRUPLE EXPANSION ENGINE OF THE KOREA, ERECTED IN THE MACHINE SHOP.

In the forward end of the music room is a piano flanked by mahogany music stands and bookcases. The whole is abundantly lighted by electricity and each booth has its separate group of lights. Just abaft


Shaded Holes are for Screw Stays
Rivets 1 7/16" Dia.
Hole 1 1/2" Drilled
1 7/16 Rivets
1 1/2" Hole
Strength of Joint
Rivet = 5 x 1.62 x 85 x 1.75 / 9.25 x 1.625 = 80.26%
Plate = 7.75 / 9.25 = 83.7%
Double Butt: Equal Width; 1 1/4" Thick
6" 1 1/8" Rivets; 4 1/4" Pitch
4 Threads per in.
3 5/8"
30 1/2"
29 1/2"
2 5/8" Lap
20'3" over Tube Sheets
7'2 1/4" over T.S.
7'2 3/4" over T.S.
128 Ordinary Tubes 2 1/2" outside Diam. No. 10 B.W.G. Thick
48 Stay " 2 1/2" " " 5/16 Thick
5/8" Rivets; 2 1/8" Pitch
1 1/2" Screw Stays 12 Th. per in. Nuts 1" Deep on sides
1 3/8" Rivets; 2 1/2" Pitch C.S.
1 3/4" Screw Stays in back; 10 Threads p. r in.; Nuts 1 5/8" Deep
1 1/2" Screw Stays 12 Th. per in.
8'1 3/4"
3" x 3" x 1/2" L
Where Stays do not come square with Plate; Bevel Washers to be used.
6" x 3/8" Washer
16'0" Mean Diam.
Middle Butt
End Butt
84"
87"
84"
Marine Engineering
2'10"
About 3'4 1/2"
About 5'8 3/4"
16"
7/8" Rivets; 2 1/8" Pitch; C.S. and Flush
5/8" Stiffening Plate; 1" Rivets about 6" Pitch; C.S. and Flush.
34 Stay Tubes
101 Ord'y "
40 Stay Tubes
113 Ord'y "
1 1/2" Screw Stays; 12 Threads per in.
5'0 3/4" R.
3/4" Stiffening Plate
2-Wing Manholes in one end
1-Center " " other

DOUBLE END BOILER FOR THE KOREA. THERE ARE SIX OF THESE AND TWO SINGLE END OF THE SAME DIAMETER.

the music room are four sets of staterooms en suite. The two sets on the starboard side of the ship are finished in mahogany and those on the port side in quartered oak. Each set consists of a sitting room, stateroom and private bath and closet. The sitting room is furnished with upholstered transom, folding corner lavatory and writing desk, each stateroom with solid brass bedstead, transom and folding lavatory, and each bath room with water closet and solid porcelain tub with hot and cold water. The passages are all carpeted and finished in white panels with cherry wainscoting.

On the extreme after end of the promenade deck house is the smoking room, having an outlook aft and on both sides of the ship. It is tiled in red and white rubber, upholstered in red plush and the woodwork is cherry of a rich wine color. The panels are lincrusta finished in old Dutch gold. In the center is an enclosed buffet for the accommodation of passengers. On each side, and around the ends of the houses on this deck, is an uninterrupted promenade 550 feet in the circuit, or over a tenth of a mile.

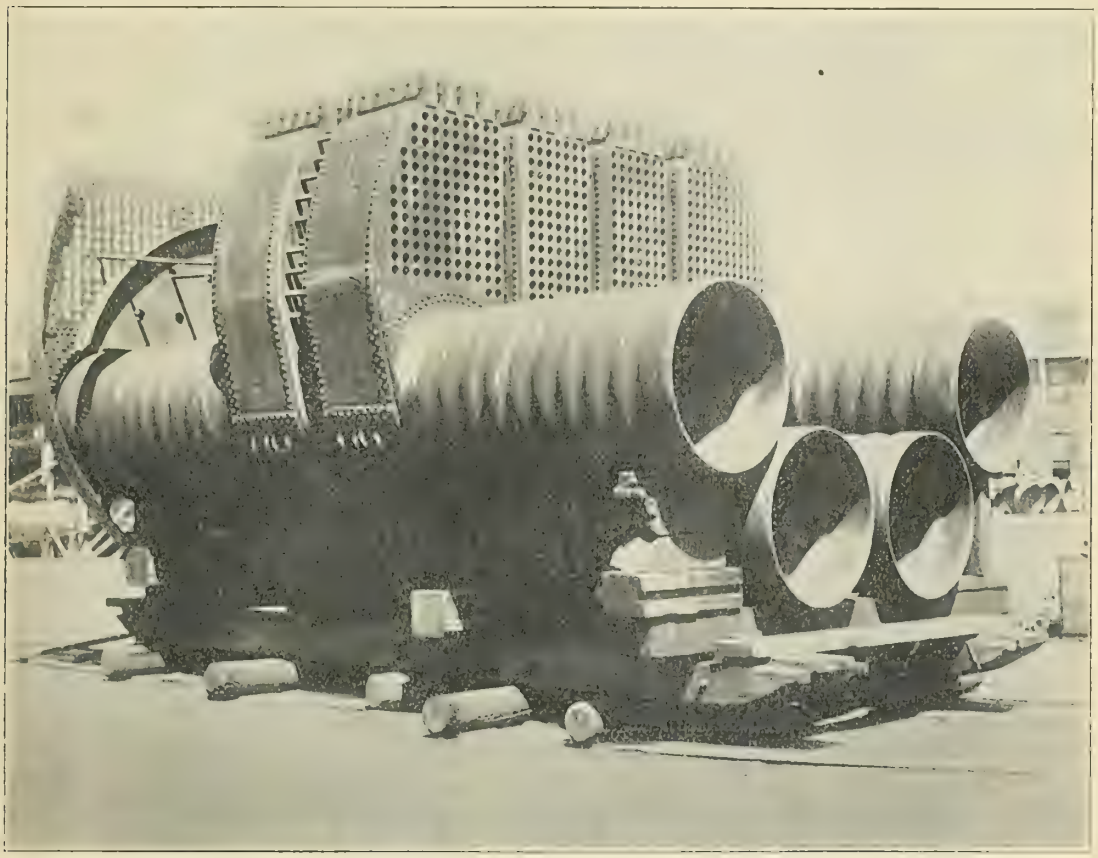
The plumbing arrangements for first-class passengers are most elegant and elaborate. Extensive toilet rooms are provided for ladies and for gentlemen on both the upper and the promenade decks, all floored in mosaic marble tile. The water closets in all are in stalls separated by opalescent glass partitions. Each closet has separate flushing valve and all nickel fittings. The bath tubs are solid porcelain embedded in the tiled floor, and each bath room is provided with a folding wooden seat.

The galley and pantry arrangements are also extensive and all are fitted up in the most modern style with every possible convenience for rapid and efficient service. The pantry opens directly off the main dining saloon with double swinging spring doors between, and a screen on the pantry side.

The servants' and crew's quarters are ample and are all fitted in a neat and comfortable style. The crew's and steerage wash rooms and water closets in the forecastle are floored with cement tile and fitted with wash troughs and with galvanized iron latrines with intermittent flush. The same is true of the firemen's and stewards' quarters under the poop. The white steerage forward on the main deck is fitted permanently in a neat fashion. The spaces forward and aft on the main deck are fitted for cargo or for Chinese steerage. For the latter purpose portable metal standee berths are provided. All steerage spaces are light, airy and well ventilated.

A most thorough and efficient ventilation is provided for all first-class passenger spaces by means of electric fans and ventilation ducts.

Aft on the starboard side is the bridge house; near the purser's office and stateroom is a doctor's room



COMBUSTION CHAMBERS AND FURNACES FOR ONE OF THE DOUBLE END BOILERS OF THE KOREA.

and also a barber shop. The chief engineer's stateroom is a large room opening directly off the engine hatch on the promenade deck.

On the main deck just forward of the machinery space is a large baggage room, and also a mail and specie room, with every facility for handling baggage through the cargo ports in the immediate vicinity.

At the time of their launch these ships had reached the great weight of about 7,200 tons. The sliding ways were about 470 feet long under the packing and 3 feet 6 inches wide each, thus giving an average pressure of about 2.2 tons per square foot. The pressure on the fore poppets at the point of pivoting was estimated to be about 1,400 tons. The ships slid about 468 feet to the point of pivoting, and the time from sawing off to pivoting for the *Korea* was 42 seconds. The packing aft under the heavy sternpost and struts was necessarily of an unusually extensive character. The whole method of packing and launching was that which has been used so long by Mr. M. V. D. Doughty, the superintendent of hull construction at the yard, and which has accomplished a very large number of successful launchings. The launchings of these two immense vessels were carried on with the precision of clockwork and were as eminently successful as those that had gone before.

The *Korea* went on a 36-hour sea trial on March the 20th at her load draft of 27 feet 0 inches. This trial was most successful, and the engines were not stopped from the time she left the dock until she reached it again. Under forced draft the engines made 89 revolutions and developed 17,900 indicated horse power. The log indicated a speed of 20 knots, and a rough check on a known course indicated about the same speed. At least the anticipated speed of 18 knots was easily exceeded and should not be difficult to maintain on her regular runs.

The boilers steamed easy and there was remarkably little vibration at any speed of the engines. The ship encountered a northwest gale of considerable violence and rather a heavy sea, but she stood up to it exceedingly well and gave every indication of being a good sea boat.

New Floating Dock at Seattle, Wash.

The accompanying engravings show the floating dry dock recently put in service by Moran Bros.' Company. It is the first of two similar sections of a combined lifting capacity of 5,000 tons. This section is 85 feet wide over all, 57 feet between towers, and 250 feet long. The keel blocks are located 4 feet center to center. The dock is built very heavily of timber, and the main pontoon is divided into twelve compartments. Each tower is divided into three compartments, making in all eighteen compartments. The water level in each one of these compartments is plainly shown by pole indicators located on the top of the towers. The pumping machinery consists of centrifugal pumps, each run by an electric motor, and the operation of the dock is controlled entirely by one person situated in the conning tower, which, as shown in the engraving, is located at one end of one of the main towers.

FLOATING DOCK AT SEATTLE ABOUT TO BE LAUNCHED.

The dock is giving highly satisfactory service and work on the construction of the second section is soon to be started.

Salving the Flottbek.

During the gale of November 23rd the German ship *Flottbek* was driven ashore at Long Branch, N. J., and at low tide was left in the position shown in the accompanying engraving. Upon examination it was found that the steel hull of the ship was practically uninjured. That the ship escaped striking any of the numerous jetties that are built along the beach at this point was almost miraculous. As shown in the engraving, she lay fast in the sand directly between two of these jetties.

The Merritt and Chapman Derrick and Wrecking Company undertook to pull the vessel off; her topmasts and yards were lowered and most of her cargo, which consisted of China clay and arsenic, was discharged. Two anchors were taken out astern in the direction from which the ship had come when she struck, and by these the ship was held from being driven further on to the beach and the cables were laid to windlasses. Preparations were completed and the crew waited for another storm to agitate the water and sand around the stranded vessel, and, on December 17th, when such a storm came, the cables were hauled in by working the capstans, and the ship was successfully floated.

This strip of Jersey coast is the scene of many wrecks. The *Flottbek* was built by Swan and Hunter, at Newcastle, in '91, and is 273 feet long, 42.1 feet broad, 24 feet deep, and of 1,888 tons.

GERMAN SHIP FLOTTBEK ASHORE ON THE JERSEY COAST.

Shipping Combine.—Laird's Shipbuilding Company, of Birkenhead, England, has taken over the adjoining Jones Shipyard gaining control of a large area of the Mersey. This combine now intends to compete with the leading shipbuilders of the country for building ships of the largest class.

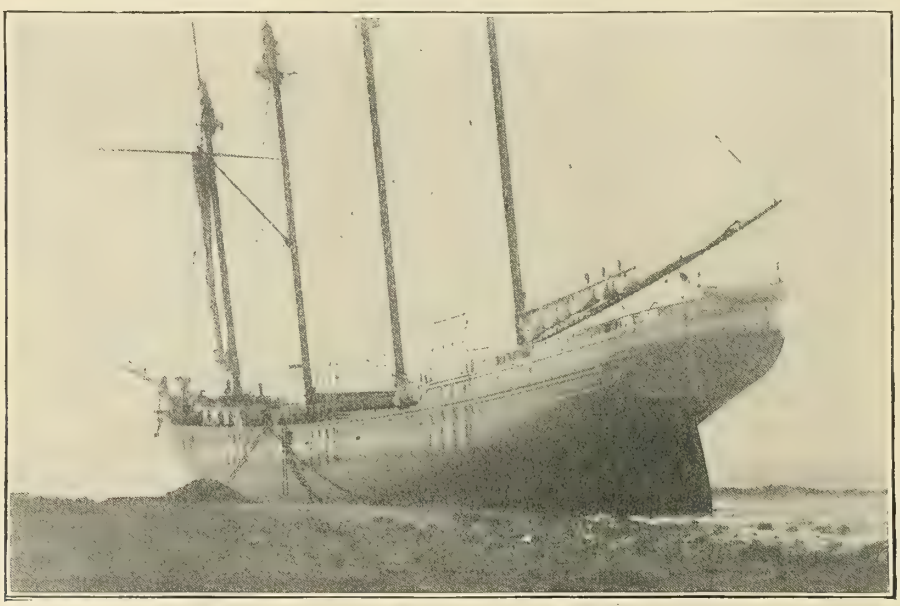
Lake Shipbuilding.—The Great Lakes are building a larger number of merchant ships than ever before in their history, although the cost is less than that of the vessels under way a year ago. The 500-foot class that seemed two years ago to be the coming type, is being replaced by ships of from 400 to 430 feet long, carrying from 5,000 to 6,000 tons. There are twenty-eight steel cargo ships under way in the yards of the American Shipbuilding Company, and every one is of this type.

Steamship Traffic of the Northwest.—The development of the shipping business of the Pacific Northwest has progressed with remarkable strides during the last few years. Fifteen years ago there were two steamships in this trade. To-day the list of foreign steamships en route for and in port at Portland, Seattle, Tacoma, Vancouver and Victoria includes 45 big carriers ranging in capacity from 4,500 tons to 10,000 tons, the net registered tonnage of the fleet being over 108,000 tons, and the carrying capacity about 250,000 tons. Despite the enormous carrying capacity of this fleet the business of the sailing ships has not decreased, but increased.

Schooner on Shore.

Herewith are presented two interesting photographs of the schooner *Minnie A. Craine*, which was thrown on the beach on the west side of Smith's Island, Puget Sound, during a severe storm on the night of December 25th last. Although the vessel was stranded too high to be readily floated, she is resting easily and may be saved. A portion of the keel was torn off and the damage to her bottom allows the sea to rise in her hold at high tide. She was built by Moran Brothers, Seattle, during the year 1900, and is of the following dimensions: Length, 205 feet 9 inches; beam, 42 feet 2 inches; depth, 16 feet 7 inches. She was very heavily built throughout, her rigging and fittings were the best, as was the workmanship, and it is hoped that these qualities will maintain the vessel in good condition long enough to enable her owners to restore her to the intended element. She left Puget Sound with a cargo of lumber for Australia almost exactly one year before the ill-fated day on which she re-entered the Sound to be wrecked as above described.

BOW VIEW.



SCHOONER STRANDED ON SMITH'S ISLAND, PUGET SOUND.

Steel Famine.—Owing to the unprecedented demand of steel for structural work, all of our shipyards are suffering because of the impossibility to get deliveries of steel from the mills. All plants report that they are far behind with their orders.

Losses on Torpedo Boats.—The board of naval officers, of which Rear Admiral Francis M. Ramsay was chairman, appointed by Secretary Long to fix the amounts lost by contractors in constructing torpedo boat destroyers and torpedo boats for the government, has reported that the average loss on each destroyer was $87,459 and on each torpedo boat $72,531. The total loss of the contractors on the sixteen destroyers, as fixed by the board, was $1,399,340, and on torpedo boats $652,778, a grand total of $2,052,118. These figures will be sent to Congress for its information in considering claims of the contractors for reimbursement to the amount of one-half their losses, or $1,026,059.

The board's report was referred to the Bureaus of Steam Engineering and Construction, which informed the Secretary of the Navy that they regard the average cost fixed by the board as fair and moderate. They say that the excess of cost over the contract prices to which the contractors were put was due to an increase in the price of material and the long periods that the vessels were under construction.

THE BALLASTING OF MODERN TANK STEAMERS.*

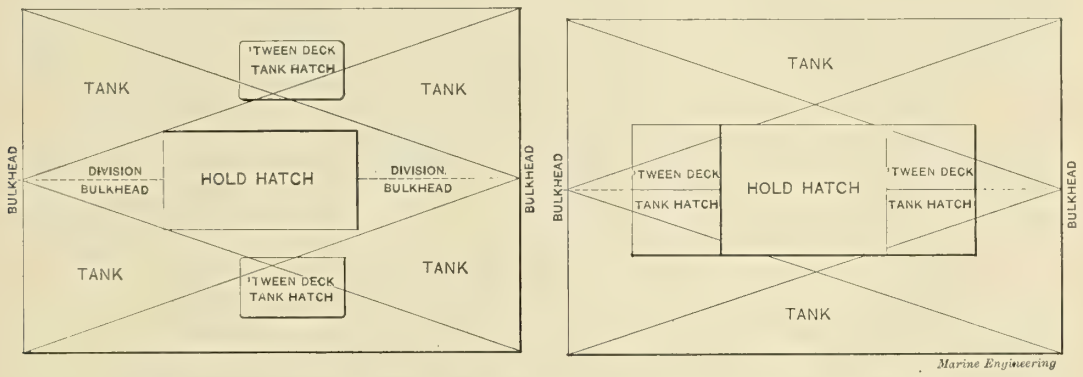
E. C. CHASTON.

If we go back to January, 1897, and take from that date the salvage cases due to broken shafts, loss of rudders, etc., up to the present time, one can only express surprise that such a state of things is allowed to exist. Writing as one who has had a practical knowledge of the subject, the writer admits that until about four years ago he was inclined to think there was something radically wrong with the shipbuilding and marine engineering profession, respecting the scantlings of both hulls and machinery. But after carefully looking into the cause of shaft breakages and disabled rudders, broken or fractured rudder posts, etc., he came to the conclusion that insufficient ballast was and is the cause of three-fourths of the whole trouble, and that it is imperative (if the shipowner will not, and the underwriter does not, insist upon a vessel being sent to sea in proper ballast trim) that there should be an under-load line fixed by the Board of Trade or the authorized freeboard-assigning authorities. With the present type of 6,900 to 7,000 tonners, length B. P., 350 feet; breadth, 47 feet; depth, molded, 29 feet 6 inches; with all tanks full, boilers full, stores on board and 600 to 700 tons bunker coals, ready to sail to the westward, the ballast draft would be approximately 12 feet 3 inches aft and 8 feet 2 inches forward, or a mean draft of 10 feet 2 1-2 inches. If we take the center line of shafting at 10 feet 6 inches from the base line of the vessel and add half the diameter of the propeller boss, say 1 foot 4 1-2 inches, this gives 11 feet 10 1-2 inches from the keel to highest part of propeller boss, or in other words the boss of the propeller is submerged 4 1-2 inches. Apart from this data, which is quite in keeping with present-day practice, the writer has often seen propeller bosses 2, 3 and 4 inches awash on vessels leaving continental and lower Mediterranean ports for United Kingdom coal loading ports.

In addition to the risk of shaft breakages, machinery damage, etc., vessels in the trim described above are quite unmanageable in a fresh breeze, due to the fact that they will not answer their helm, but fall off before the wind and become a source of danger to navigation in such places as the English Channel, Bristol Channel and Irish Sea. . . .

It is surprising to think that shipowners in far too many cases will not go to the expense of paying the cost of the necessary extra ballast to put a ship sufficiently down in the water for a run across the Atlantic light. The cost of sand ballast to-day is a mere bagatelle in comparison with the loss sustained by a long passage owing to the vessel being too high out of the water. To demonstrate the value (to shipowners) of having a ship sufficiently or properly ballasted the writer gives below the performances of a few vessels running across to North America in ballast trim. Steamship A, length, B. P., 340 feet; breadth, extreme, 45 feet; depth, molded, 28 feet; I. H. P., 1,234 to 1,250; speed, 9 knots; dead weight, 5,697 tons on a mean draft of 22 feet 10 1-2 inches. The above vessel, when water ballasted only, and with 600 tons of coals on board, had a draft of 13 feet 2 inches aft and 11 feet 1 inch forward, the distance from the base line to the center line of tail shaft being 10 feet 6 inches, the diameter of shaft 12 1-4 inches, and the diameter of propeller boss 2 feet 9 inches, thus giving 9 1-4 inches immersion of propeller boss in smooth water. The diameter of the propeller is 17 feet. This vessel used to take 19 to 25 days on the passage from the north-east coast port to Hampton Roads, U. S., and Delaware Breakwater, U. S., and invariably arrived with machinery defects and was eventually towed into the Azores with broken shaft and loss of propeller, the shaft having gone at the largest part of the cone. There was no trace of corrosion or other defects, the shaft was in perfect line, and the fracture was as clean a break as anyone could wish to see. The cause was directly traced to want of sufficient ballast. After such experience and consequent loss through delay, salvage and towage home, the owner agreed to have his ships sufficiently ballasted, with the following results, in this particular case of A, on three successive voyages:

August, 1897.—In addition to her water ballast and 600 tons of bunkers, she took 500 tons of sand ballast at 1s. 6d. per ton f.o.b., and sailed from Blyth on August 14th, arriving at the Delaware Breakwater on August



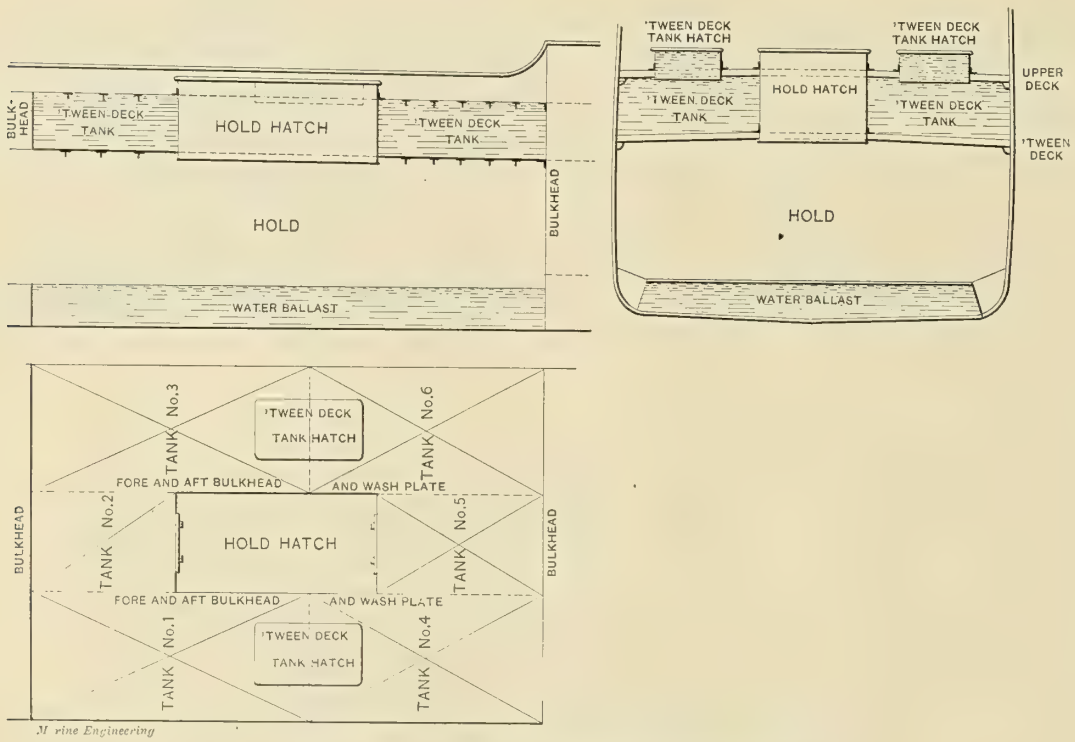
PROPOSED DECK PLANS OF STEAMERS SHOWING TWO ARRANGEMENTS OF BALLAST TANKS.

* Extract from a paper read before the North-East Coast Institution of Engineers and Shipbuilders, December, 1901.

30th, 15 1-2 days on the passage, with an average speed per day of 228.9 knots.

October, 1897.—Left the Tyne on October 11th for Hampton Roads. Arrived there on October 29th. Average speed per day 221.9 knots over a period of 17 days. She had on this voyage 750 tons of sand ballast at 2s. per ton f.o.b., about 400 tons of this being on deck. The quantity of coals and other conditions were the same as previous voyage.

December, 1897.—Left the Tyne December 12th for Hampton Roads and arrived December 31st. Average speed over a period of 18 1-2 days, 194.5 knots. During this passage some exceptionally bad weather was experienced, and innumerable vessels put back in distress and in a more or less disabled condition. The writer does not wish to state any more cases in detail, but he had data of four ships similar to A, during the same work or voyages, viz., to the United States in ballast regularly and home with cargo. The approximate drafts, with sand ballast, were 17 feet 8 inches aft and 13 feet 6 inches forward, ranging down to 16 feet 4 inches aft and 13 feet forward, according to time of the year. The speeds given in ship A are not necessarily given to show the speed of the vessel, but to show the regularity of speed or passages made. Machinery damage was practically nil, there being no shaft breakages or rudder defects during the last four years. After experiences like the above one would wonder at any shipowners allowing their ships to proceed to sea insufficiently ballasted and with such absurd drafts as 12 feet 3 inches aft and 8 feet 6 inches to 10 feet 3 inches forward. On ships of the above types, class and dimensions, the writer is not necessarily advocating sand ballast, but ballast in any shape or form according to the exigencies of the case. Furthermore, he is aware of the fact that some shipowners are now having a special deep tank in the hold immediately aft of the engine room bulkhead. Others again are, he believes, having ballast tanks arranged in the side tanks as advocated by Mr. A. McGlashan in his paper read before this Institution in 1898, or in tanks 'tween decks. The writer does not advocate any special form or means of ballasting steamers, but he does wish to draw attention to the vast amount of damage done to the modern tramp steamers generally, and their machinery in particular, due to the want of sufficient ballast and to the general unmanageableness of the vessels when not answering their helms and falling off their courses into the trough of the sea, to say nothing of the great risk of life.



ARRANGEMENT OF TANKS FOR BALLASTING A MODERN TANK STEAMER.

Ballasting ought to be a more prominent feature in the design of the tramp steamer than it is at present, and the extra cost involved would be so comparatively trifling as to be scarcely worth considering. But apparently up to the present time there are still vessels building of the following dimensions:

(a) Length, B. P., 395 feet; beam, 48 feet; depth, molded, 31 feet; Lloyd's highest class; total ballast tank capacity, 1,019 tons. The approximate displacement of this vessel, with all ballast tanks full and 100 tons of coal on board, fully equipped and ready for sea trial, is 4,059 tons. The approximate drafts are 13 feet 6 inches aft, 8 feet 3 inches forward, mean draft 10 feet 10 1-2 inches; tons per inch of immersion at this draft, 37; distance from base line to center line of shaft,

10 feet 6 inches; diameter of propeller, 17 feet 6 inches; vessel designed to carry over 7,000 tons.

(b) and (c) are two sister vessels. Length, B. P., 360 feet; beam, 48 feet; depth, molded, 30 feet 10 inches; deadweight on 24 feet 6 inches, 7,000 tons; total ballast tank capacity, 896 tons; base line of ship to center line of tail shaft, 10 feet 6 inches; diameter of shaft, 15 inches. From these figures it can easily be seen that these two vessels would not have the bosses of their propellers submerged when leaving a continental discharging port for a United Kingdom loading port fully equipped, stored, and with 200 tons of bunker coals on board.

With figures like these it is no wonder we have continual breakdowns and unmanageable ships. To say the least it is a most unsatisfactory condition of affairs in regard to the ordinary tramp steamer of to-day.

ATLANTIC TRANSPORT COMPANY'S STEAM SHIP MINNETONKA.

The Atlantic Transport Company is at present having built four 600-foot vessels for service between this country and London. Two of these are building in Philadelphia, and the other two at the yard of Harland and Wolf, at Belfast, Ireland. The four vessels are to be sister ships in all general dimensions, and the *Minnetonka* here illustrated is one of the Belfast vessels. The general dimensions will be found in the tabulated form at the end of the article. The length over all is 625 feet; beam, 65 feet, and depth, molded, 44 feet. The *Minnetonka* is of the popular intermediate class of vessels for carrying cargo, cattle and first-class passengers. There are five steel decks throughout, and water bottom from forward collision bulkhead to the stern tube bulkhead.

Forward of the boiler room is a deep tank of 883 tons capacity, and aft of the engine room are five deep tanks with combined capacity of 1,208 tons. The water bottom measures 1,563 tons; tanks holding 603 tons supply water for the cattle, and there is also a 40-ton tank for drinking water.

Cargo is worked through nine hatches located along the center line of the ship. At each hatch are two steam winches. Cargo booms are swung from four pole masts and four derrick poles.

The passenger accommodations and officer's quarters are all located in the bridge amidships, and are large and airy throughout. Stalls for 804 head of cattle are built under the shelter deck. It has been the experience of all those who cross on this type of steamer that the cattle are in nowise objectionable to the passengers.

The ship is propelled by two sets of quadruple expansion, 4-cylinder, 4-crank engines. The sequence of cylinders is, from forward aft, high pressure, second intermediate, low pressure, first intermediate. Piston valves are fitted to all cylinders except the low pressure, which has a flat double-ported slide valve. Each cylinder is a separate casting, and is supported by cast iron box columns, the condenser being cast in the outboard columns. The bed plates are also cast iron and of box section.

The air, bilge and sanitary pumps are driven by levers from the first intermediate crosshead. The shafting is of mild ingot steel, the crank shaft being 18 inches diameter, propeller shaft 18 1-4 inches diameter, and intermediate shafting 17 inches. The crank shaft is of built-up interchangeable sections, set at angles according to the Yarrow-Schlick Tweedy system for the reduction of vibration. The indicated horse power of both engines is estimated at 11,000 when running at 75 revolutions per minute.

The propellers are three bladed and of sectional type, with cast iron boss and manganese bronze blades. The diameter is 18 feet 6 inches, and pitch, 23 feet 6 inches.

Steam is supplied by four double end and four single end boilers, equipped with Howden's forced draft system. The dimensions of the boilers are given in the accompanying table. The air is supplied to the boilers by three fans. There is also one fan for ventilating the stoke hold.

There are four feed pumps of the Weir type with automatic control. There are also two auxiliary feed and general service duplex pumps of the Admiralty type made by the shipbuilders. The fire and fresh water pumps supply deck service and sanitary tanks with salt water, and the cattle tanks with fresh water. There is a centrifugal circulating pump for each main engine, and one for the auxiliary condenser which is used in port, and which receives steam from the winches. These centrifugals, together with the auxiliary condenser and air pump, are made by the shipbuilders. An evaporator of 50 tons capacity, a distiller of 5,000 gallons capacity, and a feed water heater are also supplied.

The electric lights are operated by three direct connected engines of 25 kilowatts capacity.

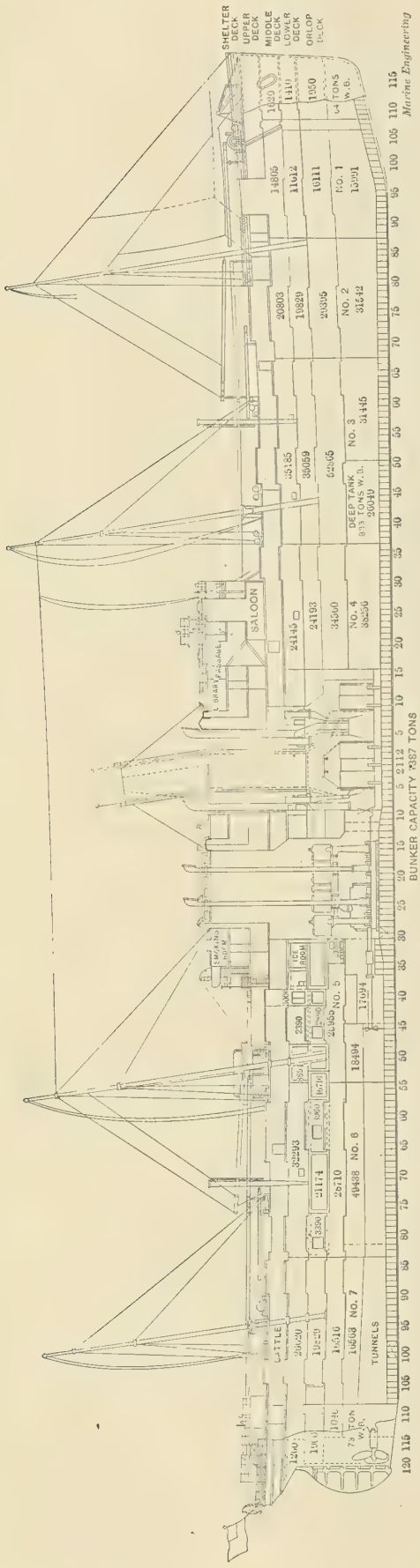
There are all together about 56,000 cubic feet of insulated chambers for the preservation of chilled beef, butter, etc., and for the carriage of ship's stores. These are cooled by the carbondioxide system of refrigeration, the brine being circulated through pipes in the chambers. The refrigerating machine is located in the engine room between the thrust blocks.

The steering gear is made by the shipbuilders of the Wilson and Prince design, and is located in the house aft, with the gear directly connected to the quadrant. There are two engines on sliding beds, each of sufficient size to steer the ship.

Shipbuilding Returns.

Returns to the Bureau of Navigation show that during the first nine months of the current fiscal year, ended March 31, 1902, there were built in the United States and officially numbered 949 vessels of 245,068 gross tons. For the corresponding period of the previous fiscal year the figures were 753 vessels of 246,973 gross tons. These figures do not include canal boats and unrigged barges.

A gain of about 8,000 tons on the Atlantic seaboard is offset by losses of about 5,000 tons on the Lakes, 3,000 tons on the Pacific, and 2,000 tons on Western rivers. Of the nine months' construction only 57 vessels are over 1,000 gross tons each, aggregating, how-



SECTIONAL ELEVATION OF THE STEAMSHIP MINNETONKA, SHOWING THE CAPACITY OF HOLDS IN CUBIC FEET BUNKER CAPACITY 1387 TONS

ever, 169,566 tons; or 70 per cent. of the total tonnage. Of these large vessels the Great Lakes have built 22 steel steamers of 84,323 tons. Two of these, *Watson* and *Buckman*, of 1,820 tons each, are banana steamers for West Indian trade; one, *Hugoma*, of 2,182 tons, is for the Porto Rican trade, and one, *Minnetonka*, of 5,270 tons, is to be cut in two to pass the Canadian canals, and then rejoined for ocean trade.

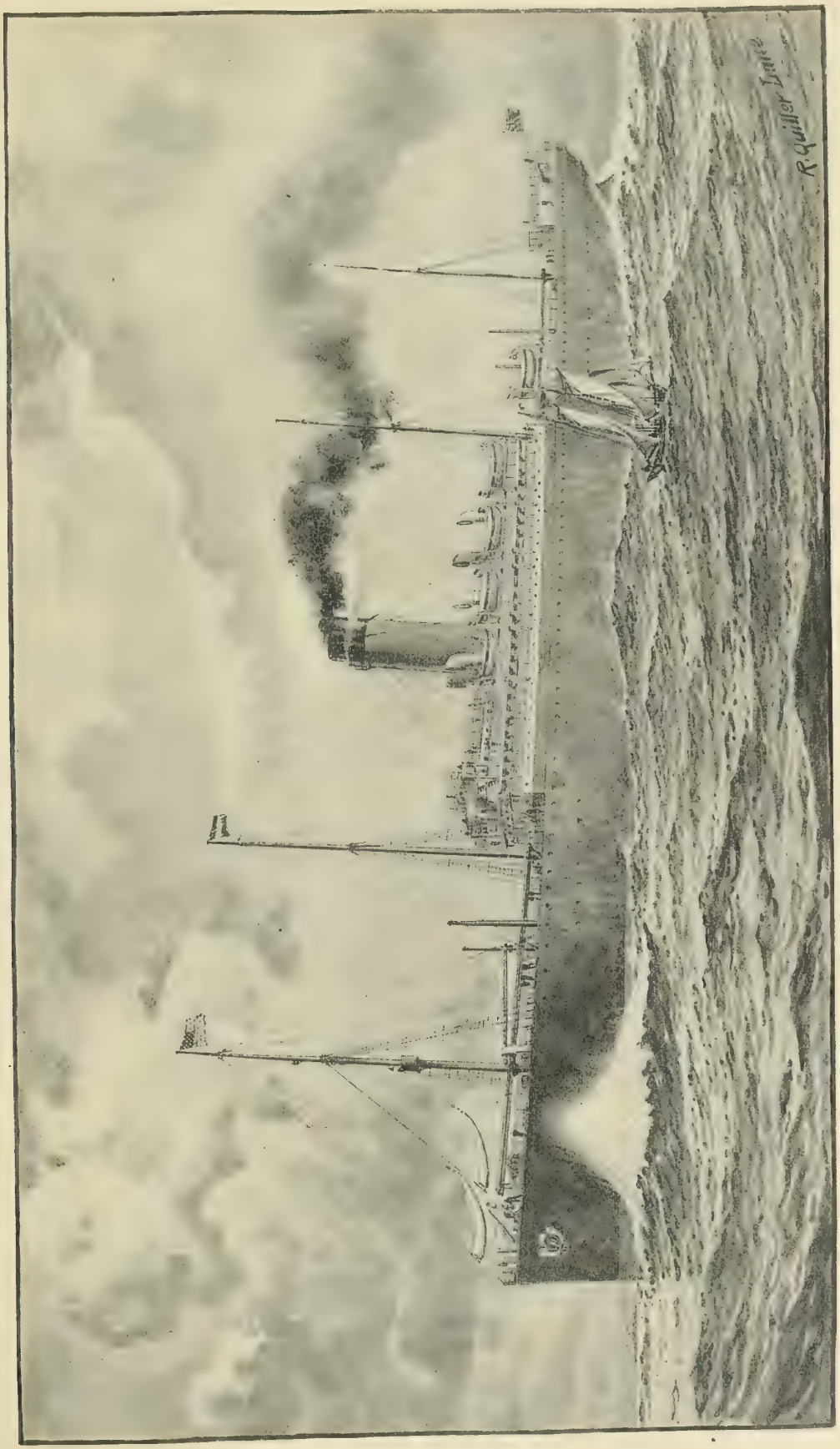
The seaboard has built 10 steel steamers of 41,204 tons, of which the largest is *Korea*, 11,276 tons, a Pacific Mail steamer for trade from San Francisco, via Honolulu to Hongkong, with possible extension to the Philippines. One, *Nevadan*, 4,408 tons, is for the New York-Hawaiian trade; one, *Pathfinder*, 2,792 tons, is for the Porto Rican trade; one, *J. M. Guffey*, 2,520 tons, is for the Texas petroleum trade. The others are for the usual coasting trades.

The advanced construction of vessels launched, or soon to be launched, indicates that the total construction for the year will somewhat exceed that of the fiscal year 1901. Contracts for new work are, however, less than a year ago.

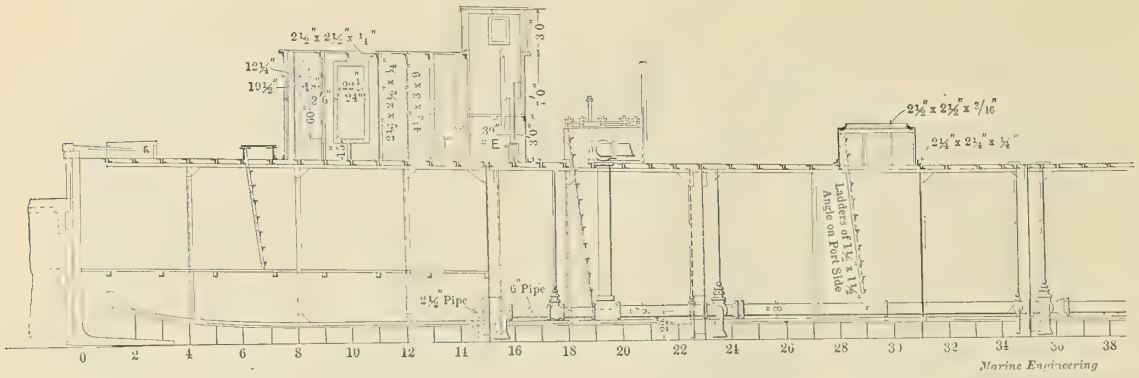
NAME—Minnetonka. NATIONALITY—British. TYPE—Intermediate Freight and Passenger.

LAUNCHED—1901. BUILDERS—Harland and Wolff.

Length over all	625 ft.	Type	4 cyl. quad. expansion 4-crank
" between perps	600 "	Cylinder diameters	30, 43, 63, 89 in.
Beam	65 "	Stroke	60 "
Depth molded	44 "	Designed R. P. M.	75
Load draft	33 ft. 2 in.	" I. H. P.	11,000
Corresponding displacement	26,530 tons	" speed	16 knots
Dead weight capacity	13,610 "	Condens. surf	13,300 sq. ft.
Coal bunkers	1,890 "	Balance	Yarrow-Schlick-Tweedy
Tanks		Valves	Piston on 3 cylinders
Forward deep tank	883 "	**Boilers**, numbers	4 single, 4 double-end
5 deep tanks aft	1,208 "	Pressure	214 lbs.
Fresh water for cattle	603 "	Diameter	14 ft. 5 in.
Drinking water	40 "	Length, double-end	19 " 1 "
Water bottom	1,569 "	" single-end	11 " 0 "
Total capacity of tanks	4,303 tons	Furnaces, single-end	3
Gross tons	13,401 tons	" double-end	6
Net tons	8,651 "	Diameter of furnaces, internal	4011 ins.
Propellers, No. of blades	3	**G. S.** total	18 "
Diameter	18 ft. 6 in.	**H. S.** total	642 sq. ft.
Pitch	23 " 6 "	Draft	26,336
Material	Cast iron boss bronze blades	**H. S.** ÷ **G. S.**	Howden
Engines, number of	2	**H. S.** ÷ **I. H. P.**	41.02
		I. H. P. ÷ **G. S.**	2.39
			18.69



STEAMSHIP MINNETONKA, BUILT BY MESSRS. HARLAND AND WOLFF FOR THE ATLANTIC TRANSPORT LINE.


2½" x 2½" x ¼"
12¼"
19½"
2½" x 2½" x ¼"
4" x 3" x ⅜
3"
E
30"
1'-0"
2½" x 2½" x 5/16"
2½" x 2¼" x ¼"
Ladders of 1¼" x 1¼" Angle on Port Side
2½" Pipe
6" Pipe
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38
Marine Engineering

LONGITUDINAL SECTION

OIL BARGES.

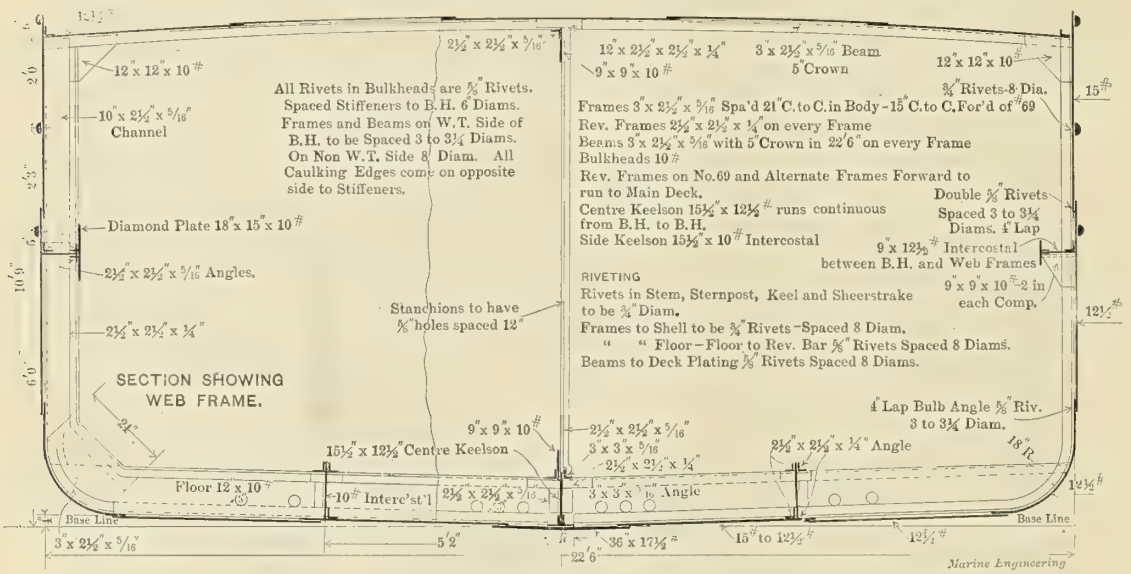
BY EADS JOHNSON.

With the recent development of the Texas oil fields, the question of transportation and distribution of oil has atracted considerable attention. A brief sketch of the construction of oil barges may be of interest to prospective investors in oil and builders of oil carrying craft.

The essential features connected with the construction of steel barges and steamers for carrying oil, occur, requires reaming and the use of a large size rivet. To quote Thomas Walton in his recent edition, "Steel Ships and Their Construction": "Bad riveting spells *doom* to an oil carrying vessel." This may not be too seriously considered, for where there is leaking oil, there is an explosive gas that is very dangerous. As a matter of fact 90 per cent. of the accidents to oil carrying ships has been traced to bad riveting.

VENTILATION.

Oil gas is very inflammable and should be removed

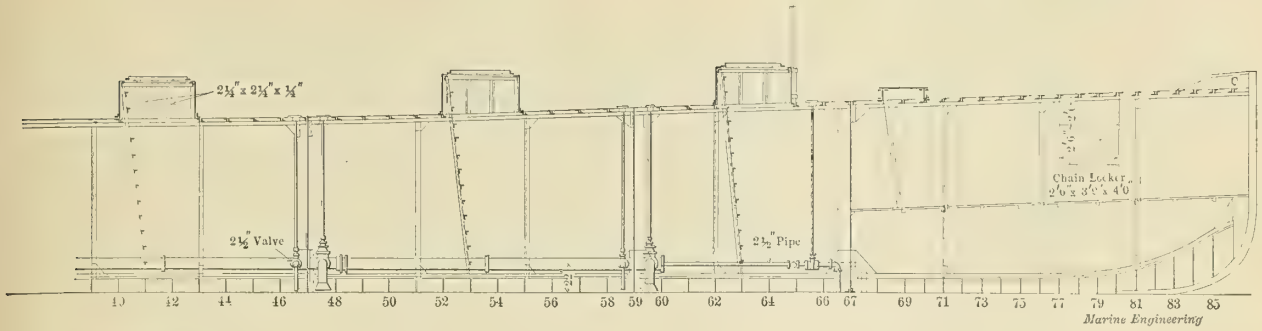

12" x 12" x 10#
10" x 2½" x 5/16" Channel
All Rivets in Bulkheads are ⅞" Rivets.
Spaced Stiffeners to B.H. 6' Diams.
Frames and Beams on W.T. Side of B.H. to be Spaced 3 to 3¼ Diams.
On Non W.T. Side 8' Diam. All Caulking Edges come on opposite side to Stiffeners.
Diamond Plate 18" x 15" x 10#
2½" x 2½" x 5/16" Angles.
2½" x 2½" x ¼"
SECTION SHOWING WEB FRAME.
Stanchions to have ⅞" holes spaced 12"
2½" x 2½" x 5/16"
12" x 2½" x 2½" x ¼"
9" x 9" x 10#
3 x 2½" x 5/16" Beam
5" Crown
12" x 12" x 10#
¾" Rivets-8 Dia.
Frames 3" x 2½" x 5/16" Spa'd 21" C. to C. in Body - 15" C. to C. For'd of #69
Rev. Frames 2½" x 2½" x ¼" on every Frame
Beams 3" x 2½" x 5/16" with 5" Crown in 22'6" on every Frame
Bulkheads 10#
Rev. Frames on No. 69 and Alternate Frames Forward to run to Main Deck.
Centre Keelson 15½" x 12½# runs continuous from B.H. to B.H.
Side Keelson 15½" x 10# Intercostal
Double ⅞" Rivets Spaced 3 to 3¼ Diams. 4' Lap
9" x 12½# Intercostal between B.H. and Web Frames
9" x 9" x 10#-2 in each Comp.
RIVETING
Rivets in Stem, Sternpost, Keel and Sheerstrake to be ¾" Diam.
Frames to Shell to be ¾" Rivets - Spaced 8 Diam.
" " Floor - Floor to Rev. Bar ⅞" Rivets Spaced 8 Diams.
Beams to Deck Plating ⅞" Rivets Spaced 8 Diams.
4" Lap Bulb Angle ⅞" Riv. 3 to 3¼ Diam.
9" x 9" x 10#
15½" x 12½" Centre Keelson
2½" x 2¼" x 5/16"
3" x 3" x 5/16"
2½" x 2½" x ¼"
2½" x 2½" x ¼" Angle
Floor 12 x 10#
10# Interc'st'l
2½" x 2½" x 5/16"
3 x 3 x 5/16 Angle
Base Line
3" x 2½" x 5/16"
5'2"
36" x 17½#
15# to 12½#
12½#
22'6"
Marine Engineering

MIDSHIP SECTION OF AN OIL BARGE.

over and above the necessary requirements in constructing steel ships for general purposes, may be briefly stated. Assuming that oil is to be carried solely in bulk, the practice of which is universal, special attention to the riveting, stiffening and ventilation is necessary in order to avoid serious trouble.

RIVETING.

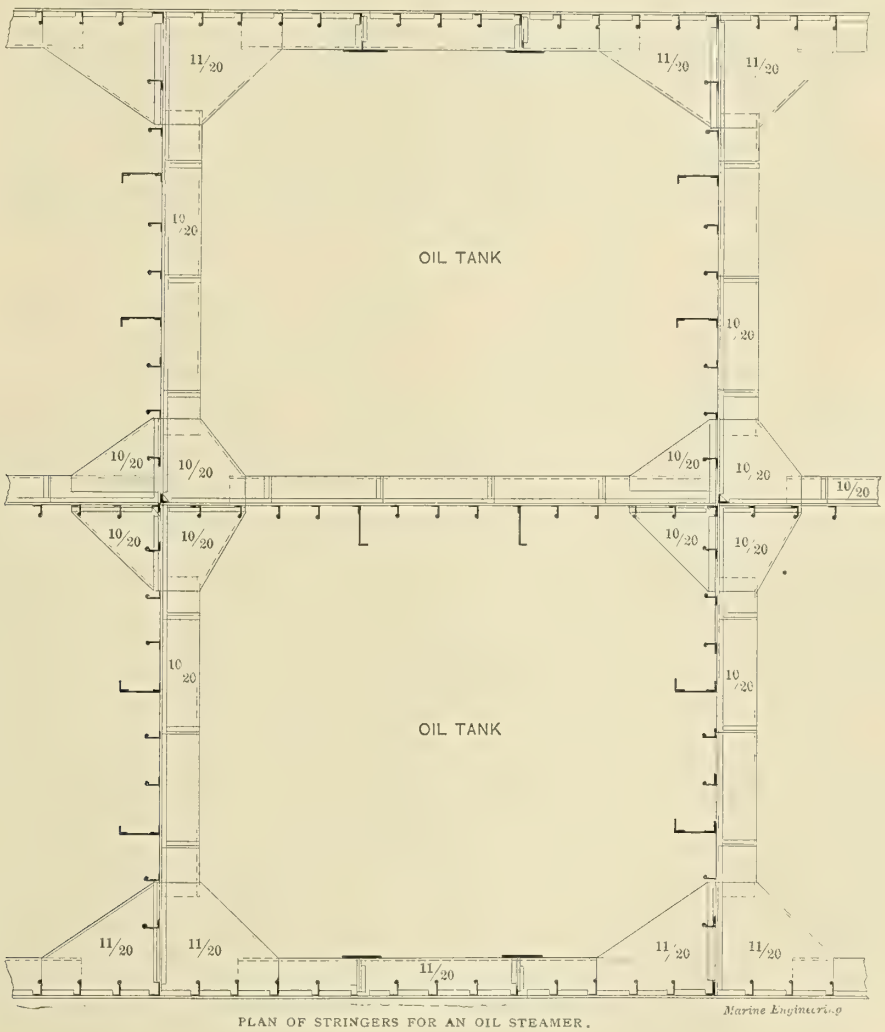
Oil tightness requires closer spacing and more efficient riveting than does water tight work. The spacing for oil tight work, by the best authorities, is 3 to 3 1-4 diameters, using pan head rivets driven countersunk. Drifting a hole to get in the rivet is bad practice, and first-class work, where blind or partly blind holes wherever found. Very little danger may be apprehended when the tanks are full of oil. Expansion hatches are provided for every tank, as shown in the longitudinal section above, and the level of the oil is carried up into these. These hatches perform a double service; first, in lessening the straining of bulkheads or sides when the vessel is in a sea way and the liquid would naturally swash from one side to the other if the compartment were not filled to the crown of the beams; and second, it leaves a smaller surface of oil from which gases may arise. As the density of oil gas is greater than that of air, it will settle and when the tanks are empty, or being emptied in port, this gas



OF AN OIL BARGE.

should be removed by suction ventilation. The oil suction pipes may be used for this purpose after the oil has been discharged.

can be used to advantage at these times in connection with the aforesaid method of using the oil suction pipes for ventilation purposes.

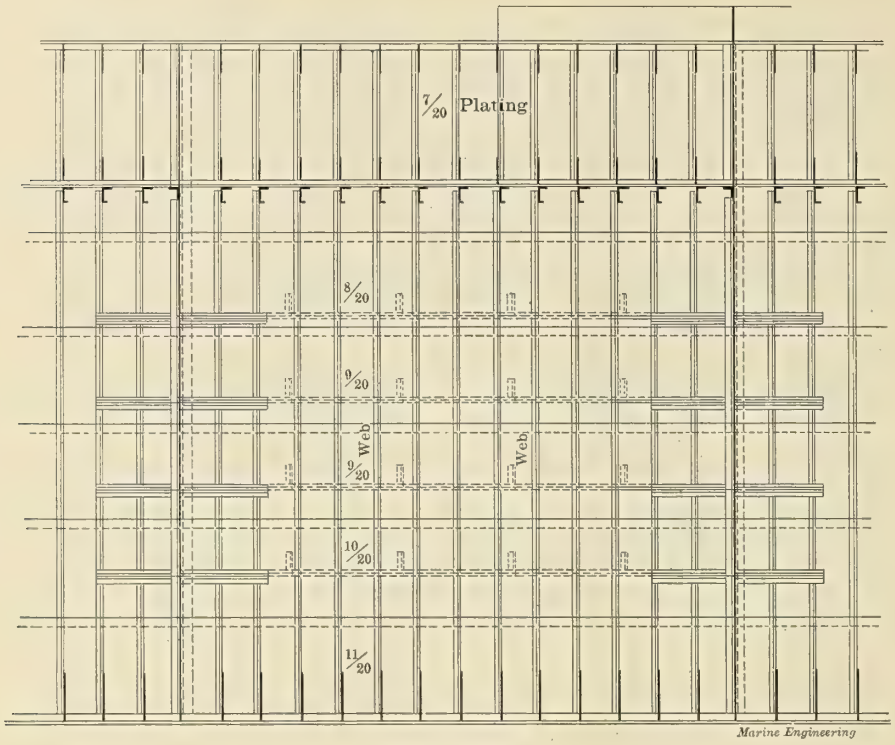


PLAN OF STRINGERS FOR AN OIL STEAMER.

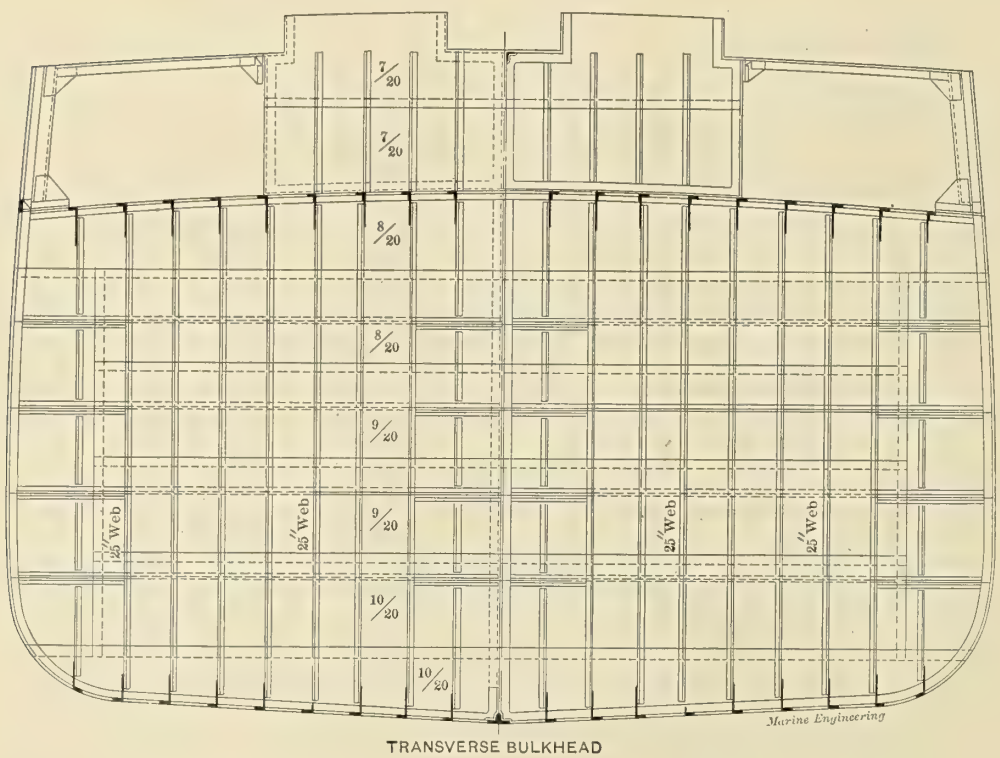
Loading and unloading are the most dangerous times, and ventilation by means of fans, although desirable, is hardly necessary or advisable, owing to extra cost of operating high speed fans, the care and maintenance of same. The familiar canvas wind sails

STIFFENING.

Ocean-going barges and steamers require extra stiffening longitudinally and transversely owing to the enormous pressure brought to bear upon the dividing bulkheads. Transverse bulkheads should be spaced

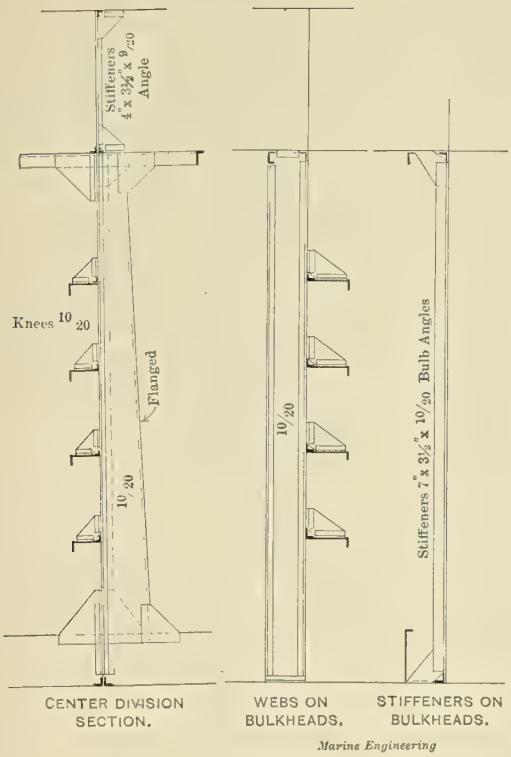


CENTER DIVISION



TRANSVERSE BULKHEAD

BULKHEAD CONSTRUCTION ON AN OIL STEAMER.



not more than 28 feet with one or more web frames within these spacings according to requirements, and a continuous longitudinal center line bulkhead is desirable extending vertically from keel to deck, and from stem to stern brought up at the ends.

The construction of oil barges recently built at one of the shipyards is shown in the accompanying drawings. On pages 230, 231 are given the midship and longitudinal sections of an oil barge built for coastwise and inland service to carry about 150,000 gallons. The barge is constructed of mild steel throughout, divided by six transverse bulkheads forming five tanks. Above each compartment is an expansion hatch. The principal dimensions are: Length, 150 feet; beam, 21 feet; depth, 10 feet 9 inches; and, draft when loaded, 9 feet. There are no pumping facilities on board, as the barge is for a special service in which there are pumping stations established at the docks at both ends of the route.

On pages 231 to 233 are shown the bracketing and stiffening of an oil steamer with carrying capacity of about 2,500,000 gallons. The ship will be 450 feet long over all, 51 feet beam and 30 feet depth. Bulb frames and stiffeners are used and have been universally adopted for this class of work. The necessary and seemingly large amount of stiffening shown in these drawings may be accepted as an example of the best modern practice. Several oil barges are at present under construction in the various yards, both on the coast and Lakes. One of these new barges will be 375 feet length over all, 360 feet on water line, 50 feet molded beam, and 28 feet 6 inches molded depth, giving a capacity of 2,000,000 gallons on 24 feet draft. On this barge the distance of transverse bulkheads is 28 feet. These are cut in way of the center line bulkhead, which is continuous throughout the cargo space and tapers down to the height of the center keelson fore and aft of the cargo space. There is a web frame in each space at the shell, also one at the center line bulkhead abreast of it and one on each transverse bulkhead on either side of the center line bulkhead. The side stringers, of which there are three on the shell side of the tanks, and four to the center line bulkhead, are intercostal between bulkheads and webs, the webs being continuous.

The completion of these vessels will mark the first of such large capacity built in American shipyards.

REFRIGERATION ON SHIPBOARD.—I.

BY E. N. PERCY.

The object of these articles is to emphasize the fact that a higher standard of refrigerating machinery ought to be required than at present for marine service; that it ought to be rigidly inspected and licensed; that it is a dangerous and important part of the machinery; and that engineers in charge ought to be closely examined in the subject, and be of unquestioned ability.

The first article will deal with the troubles, repairs and many actual breakdowns due to inferior machinery of this class. The second, with the design and economical operation of the machinery, and the standard of men that should be required. The last will deal with the design and systematic operation of the cold storage, brine system, ice tanks and details; also will touch upon ways in which the steward and butcher can save many pounds of coal used by the plant.

On a certain large ship chartered by the United States Government to take troops to Manila, the engine department had been supplied with a typical light weight refrigerating machine, of the ammonia compression type, "especially built for marine service." The expansion valve was a cheap affair, consisting of a valve with a coarse thread, and cone seat, and an oil chamber below, with a drain cock at the bottom, as in Fig. 1. As soon as the machine was started it was found that the valve could not be regulated closely enough. The machine would first be running wet, then dry. It was arranged as shown in sketch, with a long lever, at the end of which was a circular strip of steel, properly indexed. With this, a fine, accurate adjustment could be obtained.

The piping had been put in carelessly, and through careless attendance in the main engine room hot water was turned through the condenser of the refrigerator. The pressure of the ammonia went up to four hundred pounds in a few seconds, in spite of immediate efforts to correct the trouble. All the joints sizzled, and the compressor came to a dead stop. The brine circulating pump next gave trouble. It was a cheaply gotten up pump, and had a patent water piston made up of sectional rings set out by screws. This piston got to sticking, and finally collapsed. We repaired this by making a new, soft packed piston out of two plates of steel, with soft packing between.

The discharge of the compressor led into an oil separator, as the compressor operated with oil injection.

The separator was merely a piece of 6-inch gas pipe four feet high, as in Fig. 2. The oil always staid in the form of foam, and was carried over, making trouble in the condenser. Also, it should collect in the expansion valve, where it was very unpleasant to tap it off because of the odor. If the valve were opened to blow it through to the coils, the adjustment was lost, the equilibrium of the system upset, and the coating of oil inside the expansion coils decreased the efficiency, and caused much irregularity.

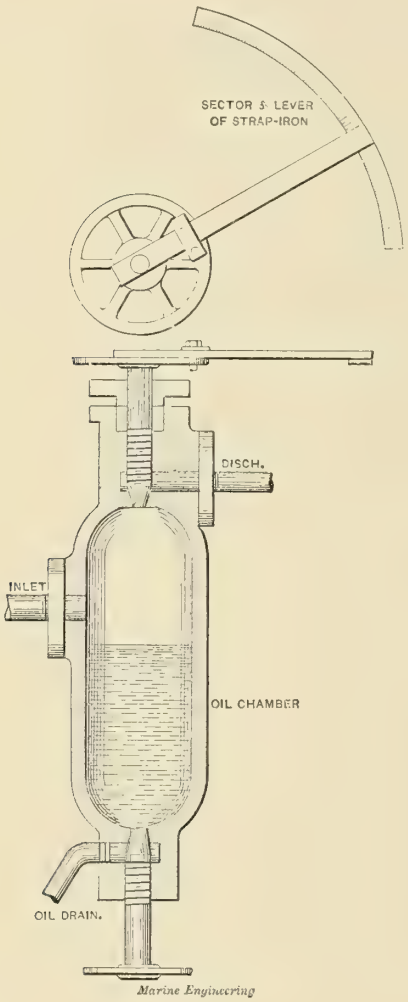


FIG. 1.

On another ship the pipe to the expansion valve did not extend to the surface of the liquid in the reservoir, and after arriving at a foreign port with provisions spoiled, it cost hundreds of dollars' worth of experimental repairs to find why the machine didn't work. In double-acting compressors, unless the oil seal stuffing boxes are long and solidly designed, they will leak and give ceaseless trouble; particularly when horizontal. On many small plants the separators, supposed to contain lime, caustic soda or potash to absorb water from the ammonia gas, are hard to get at. Many are not supplied with cut-out pipes, necessitating the closing down of the plant to do routine work. This work is painful and dangerous anywhere, and every facility should be provided for dealing with these powerful chemicals.

Many times, in the brine, or in the condenser, or even the jacket water, a white stringy substance will be noticed. This is a sure sign of an ammonia leak under (salt) water, as ammonia, added to salt water

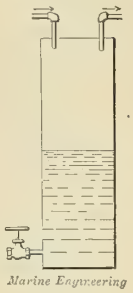


FIG. 2.

causes a rich milky precipitate, as can be easily proven by any one with common washing ammonia and salt water. The reaction is $Na\ Cl + H_4NHO = H_4N\ Cl + Na\ HO$. The sodium forming sodium hydroxide.

Oil injection machines are to be looked upon with suspicion for marine work. Not that their efficiency

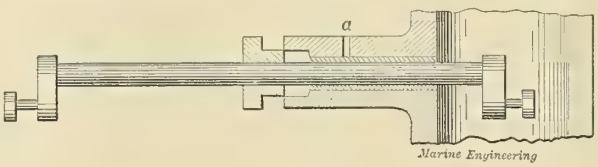


FIG 3.

is questioned, but they have an inherited proclivity for knocking out their cylinder heads, an accident both inconvenient and dangerous, considering the suffocating nature of ammonia gas. One make of machine has the crank shaft extended through a long babbitted stuffing box, with no means of lubrication as in Fig. 3. The babbitt melted out several times on one machine,

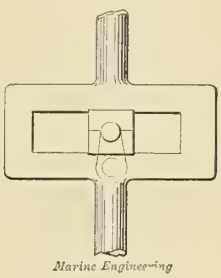


FIG. 4.

then the engineer bored a hole at (a) and put in a compression grease cup, and had no further trouble. This same compressor has a long sliding yoke, instead of a connecting rod, as in Fig. 4. Now a good running compressor should not have greater clearance than 1-32 inch, but this yoke springs so much that the crank pin brasses have to be run very loose, and the difference in efficiency with the larger clearance is quite noticeable.

Other makes have oblique suction and discharge valves. If these are cheaply made, as is often the case, they soon wear elliptical, and leak, giving a great deal of trouble, and causing great waste. One machine runs a short crank shaft, supported on two narrow bearings, with two overhung cranks; the valve is operated by a return crank from the overhung engine crank. The valve stem has no guide except its own stuffing box. This engine has to be stopped to be oiled. As it wheezed and groaned and thumped, and shook the deck, I asked, "What is the matter with it?" out of curiosity, to find out the Irish engineer's opinion. "Sure, sor, an' they allus run an ice masheen thot way." I meekly said, "Is that so?" and retired.

Ordinarily, when a machine needs charging at sea, a cylinder is laboriously carried down from the upper deck. Then, while scantily chocked on the floor, to keep it from rolling, a crazy pipe connection is made, and the ammonia is turned on, with a sure chance of breaking the pipe if the cylinder moves from the rolling of the ship, and not a chance in the world to shut it off, as the valve on the average drum is very hard to get at. There is no weighing, merely a rough guess at the pressures from the gauges.

Very frequently we hear of the ammonia pipe on a ship bursting, and often the ship returns to port, showing how serious an accident this is. Leaky fittings and poor workmanship are common defects in ammonia piping on shipboard. One engineer (?) put in some nice, new galvanized pipe for his ammonia. The way the pressure ran up, and the amount of nameless gases he blew off before his machine would "freeze" was a lesson to him for many days. Another would-be scientist engineer undertook to "neutralize" the odor of some oil he had tapped off, with concentrated sulphuric acid. He couldn't be found when the fireworks were over, and the chief got a new man. These things show the need of men *informed* upon refrigeration, and to whom it is not a science pregnant with mystery.

If an inferior quality of piping is used, the brine will soon corrode it, causing ammonia leakage, and up at the ice house the brine may leak through on to the meat; whereas, the days of "salt horse" are supposed to be done away with, if we can run our refrigerating plants properly. Where drinking tanks are cooled by brine pipes, the distilled water outside and the brine inside will eat away the pipe, the water is salted, and the blame is laid upon the innocent evaporator attendant for allowing the evaporator to flood and prime.

Another point that is not to be ignored when meat is hung closely in a storeroom, and close to the wall, it is possible when the ship is pitching, for an attendant to be severely squeezed against the wall. The writer has had several storeroom experiences in rough weather which were not entirely pleasant.

Several tons of frozen meat swinging around, one hundred pound cakes of ice skating around the floor, to say nothing of buckets, implements, turkeys, vegetables and water, all one great mess, dangerous to life, limb and stomach. With the apparatus usually provided it is difficult and dangerous to draw ice in rough weather. Also, while the cans are out, or being manipulated, much valuable brine is lost by spilling from the ice tank, as the ship pitches. This could be prevented by a by-pass pipe, with a gauge glass on the tank.

The writer had much trouble on one ship with the brine coils in the storerooms. There were two rooms, one port and one starboard. The brine supply was supposed to divide and go to each room, but in rough weather, or when the ship was listed, it would all run to one side, and if choked off by the stop valve that valve needed constant attention to adjust it to every little change of the ship or machine, and in certain positions of the ship, all the brine would run to the ice tank, leaving the pipes empty, except for the small stream supplied by the pump. These pipes were strung around each room in one continuous spiral, without manifolds. The frost would gather so heavily on the first part of the pipe that it could not be scraped off, hence the temperature of the rooms never got below the melting point of ice, and the brine was so warm after coming out that it could not be used in the ice tanks, frequently returning to the machine at a temperature of 45 degrees Fahrenheit. The most of this heat went to make the ice on the first half of the pipes in the storerooms.

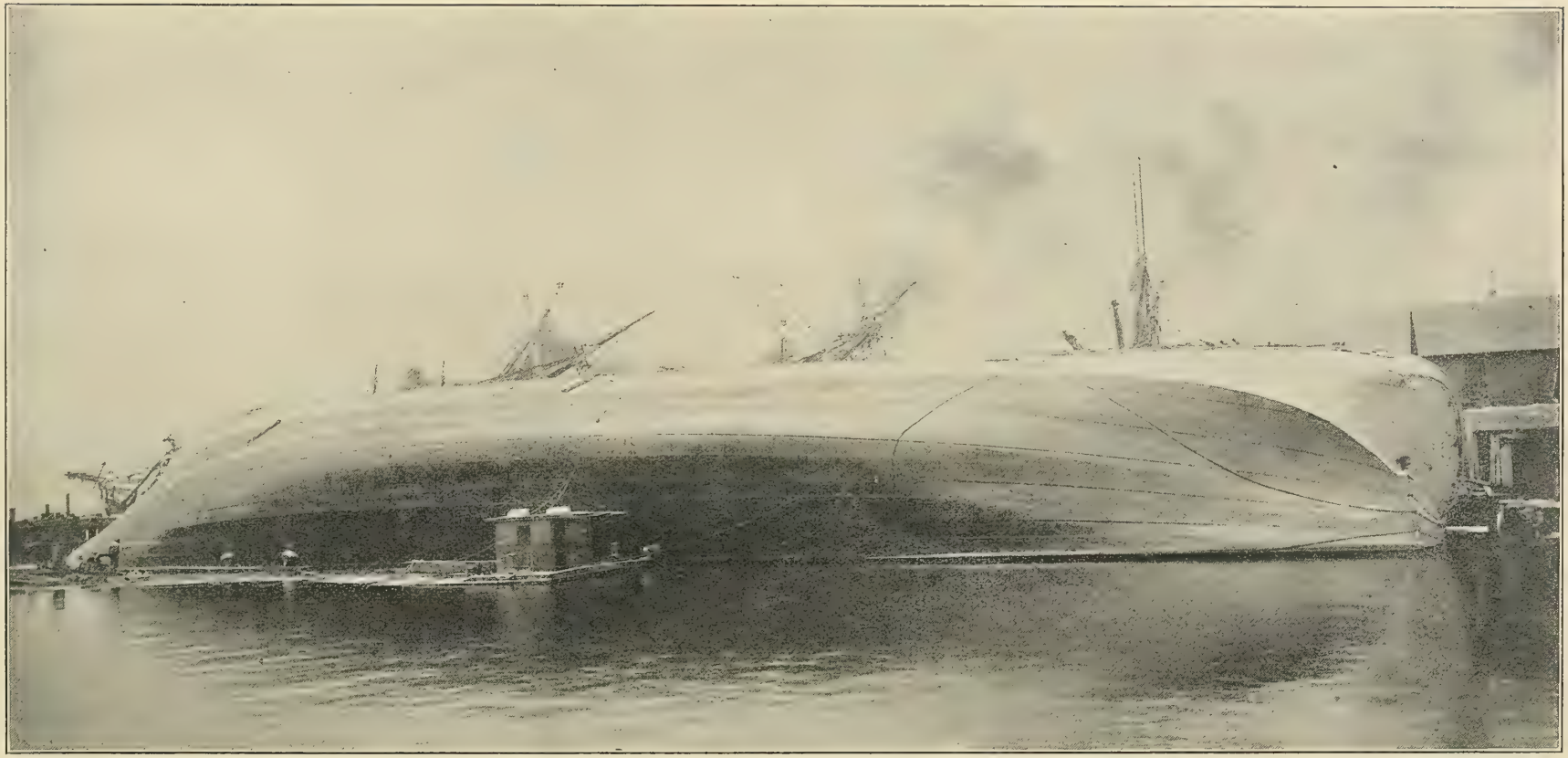
From this, we can justly conclude, I think, that a poor class of refrigerating machinery is used for marine purposes, and we stand in need of solid and economical designs, men skilled in handling them, and laws to enforce this. In this article no mention has been made of the number of people hurt or the inconvenience experienced through failure of apparatus, as the writer does not wish to direct attention to the failings of any particular company or manufacturer.

Careening Ships.

Editor of Marine Engineering:

I was very much interested in seeing in a recent number the illustrations of the New Bedford whaling vessels undergoing repairs, and beg to call to your attention that this method of repairing the bottoms of ships is not confined to the New England ports. At Pensacola, Fla., large and small vessels are frequently repaired in this manner. In fact, the bottoms of so many ships have been overhauled by careening them that it is an ordinary thing to see a large vessel at the wharf lying on her beam ends.

To illustrate the methods used at Pensacola, I am sending you two photographs taken not long ago of the English ship *Yarkand,* which went ashore in the Gulf during a gale and was brought for repairs to Pensacola. Strong backs were placed from the main and foretops to the gunwale and then a block and fall were led from the wharf to each of the tops, and the lines carried to a small hoisting engine, which is seen on the dock. Hose from suction pumps was led to the hold in case the ship should take water, and, when all was ready, the hoisting engines were started and down went the ship. Sometimes ballast is used to facilitate this operation. When the vessel is all over, the keel is entirely out of water, and the workmen, from rafts and staging brought alongside, can get at any part of the bottom plating.

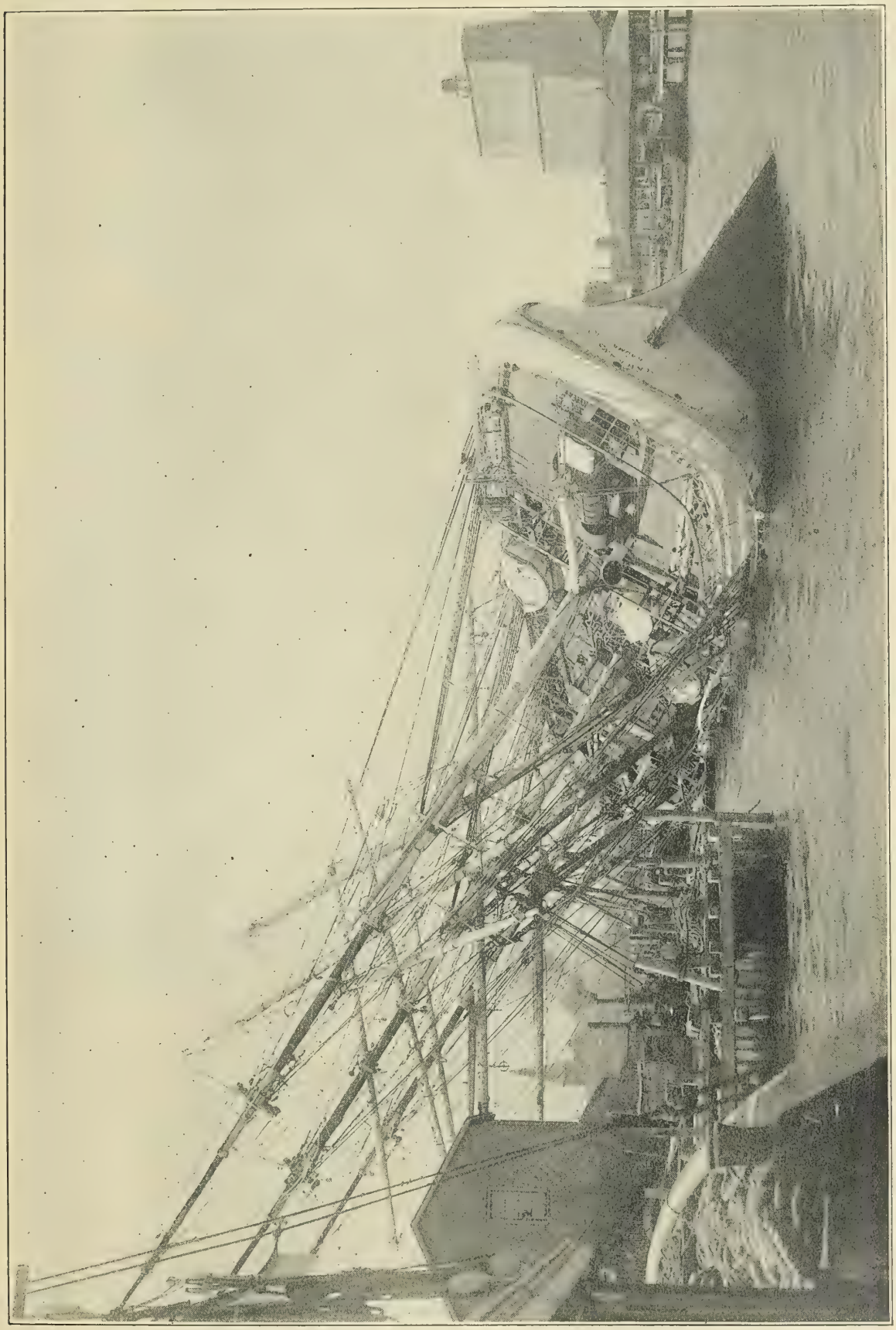


SHIP YARKAND CAREENED FOR REPAIRS AT PENSACOLA, FLA.

In the case of the *Yarkand* a damaged plate was removed and replaced while the ship was in this position. The equipment on the dock is complete and so arranged that a vessel can be hauled over and repaired in very short order. This practice, instead of decreasing, is increasing, and, although there is a small marine railway at this port, many of the repairs to ship's bottoms are performed after "docking" in this manner.

H. D. F.

The Steamer City of Pekin.—On March 19th of the present year the steamship *City of Pekin* arrived at San Francisco, completing her one hundred and sixteenth round trip to Hong Kong. The first trip was made in February, 1875. The only serious breakdown met with was once when the ship was eleven hundred miles out from San Francisco, bound in. She sailed all the way in and arrived only 11 days late. Her engines have made since starting in the service 146,860,094 revolutions; she has steamed 1,594,519 miles and 345,482 tons of coal have been burned under the boilers. The *Pekin* is now on her last voyage in the San Francisco-Hongkong trade, for, by the time she returns to this country, the new ship *Korea*, building at Newport News for the Pacific Mail Steamship Company, will take her place on the line. The *Pekin* was built at Roaches' shipyard, Chester, Pa., in 1874. Her sister ship, the *City of Tokio*, was lost on the Japanese coast soon after she came out.



DECK VIEW OF STEEL SHIP YARKAND CAREENED AT PENSACOLA, FLA., FOR REPAIRS TO HER BOTTOM.

Oil Fuel Burning on the Pacific Coast.

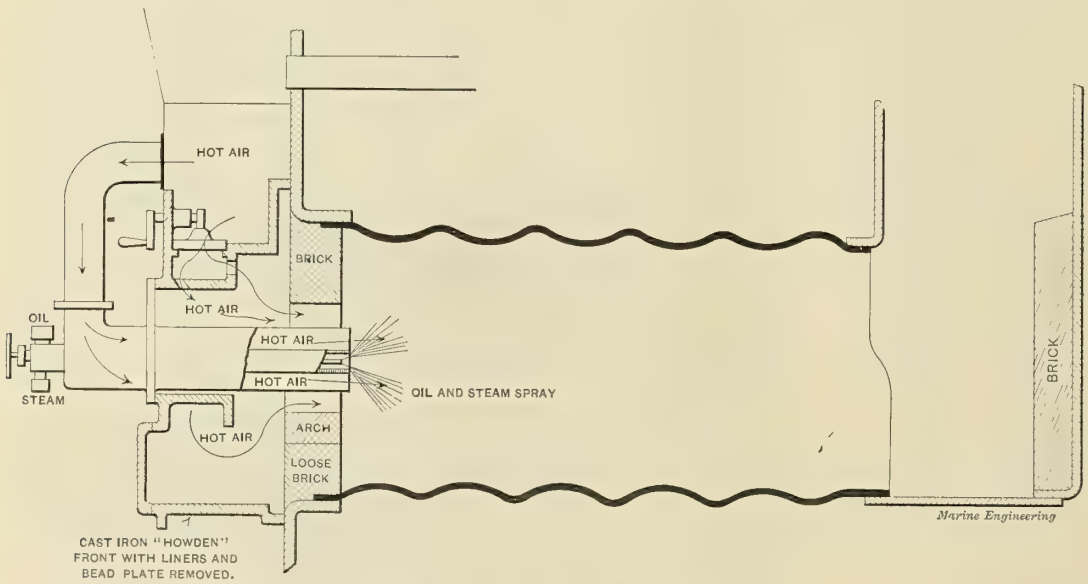
The *Journal* of the American Society of Naval Engineers contains an interesting letter on the above topic and from which we make the following extracts:

Bakersfield oil is sold at 85 cents per barrel of 42 gallons, delivered. It is an average of 16 degrees Baume with an asphaltum base and equally limpid at 150 degrees Fahrenheit, but cools at about 40 degrees, enough to prevent it passing through a 3-8-inch pipe with an ordinary funnel. If heated in pipes or tanks at about 200 degrees, it tends to separate and deposit carbon on the oil side of the pipe, and will also do so when heated to about 160 degrees if the heat applied has a temperature of about 150 pounds steam pressure. Therefore, any heating to make this oil fluid for pumping is best done by using exhaust steam or warm water.

In his opinion sufficient space for combustion must be secured before the gases impinge upon any surface.

This burner requires about 4.1 per cent. of the evaporation for the fan power, oil heating and steam jet. Some of the jet burners require 8 per cent. If the apparatus was left in the hands of an ordinary fireman this figure increases to 12 per cent.

Another burner used with an air pressure of about 9 ounces with no steam jet is briefly described. The air enters through a flattened nozzle at the rear, where it is controlled by a damper and passes partly over an internal tray with a wide lip with sawtooth edge over which the oil drops and is swept by the incoming air into the furnace. This is gas making in a short time and distance, and, when adjusted, gives perfect combustion at a low cost of spray.



FUEL OIL BURNER ATTACHED TO SCOTCH BOILER

Applying it to a marine boiler which was already fitted with Howden's forced-draft, the grates and bridge walls were removed and a brick wall built against the back connection sheet as a protection to the stayholt nuts. The burner was inserted in the front of the furnace and the forced-draft air ducts were used as they existed, with the addition of a pipe 6 inches in diameter from hot air duct directly to ell on burner.

After trying various burners, the one here illustrated was found best adapted to this system of forced draft. It gives a large volume of flame, which, it has been found, does not subject the boilers to the risk that jet burners have.

The writer states that, in his opinion, it is a mistake to spray the oil on a brick wall under the supposition that the wall will be hot enough to aid in raising the temperature of the flame in the furnace. With heavy oils, if combustion is not completed before an impact with the wall, a carbonaceous deposit, something like coke, will be deposited on the wall, which will burn slowly, after the oil supply is cut off, in a strong blast.

The points to be considered in fitting up oil furnaces are: Constant pressure of an oil supply at a temperature of about 170 degrees; the pump discharge should have loaded escape valve connection to the suction.

Gas traps in the piping should be carefully avoided as the gas will cause the flame to flicker and sometimes put it out. A settling tank should be provided to remove the water from the oil, the water being drawn off from the bottom of the tank; all valves and joints must be perfectly tight. The cock, with triangular hole in the plug, is a better regulator than needle valves for oil. The oil supply for combustion should surround and enter from behind the point of the burner and not be admitted all over the full width of furnace front.

Where a battery of boilers is in use, the tendency of the fireman is to get one or two boilers evaporating more than the others. To obviate this, fit thermometers in the base of smokestack or upper part of breeching, and instruct the men to try to keep the temperature as nearly equal as possible. Also, when steam jets are used insert a nipple between valve and burner, this

nipple having a hole in it just large enough to pass steam suited to the requirements of the particular burner.

Among the many patented burners there is little difference in their economy, and all depend for their economy on the cost of the spraying, which is too often left to the control of the firemen.

The results of a seven-hour test on a three-furnace Scotch boiler fitted with one Sunlight oil burner on each furnace are as follows:

Boiler, steam heating surface ..... 1,700 sq. ft.
Howden system, air heating surface..... 1,350 " "
Oil burned per hour..... 682.7 lbs.
Evaporation from and at 212 deg. per lb. oil..... 14.7 "
Steam used for atomizing oil...2.5 per cent.
" " " heating oil. ... .3 " "
" " " blower..... 1.3 " "

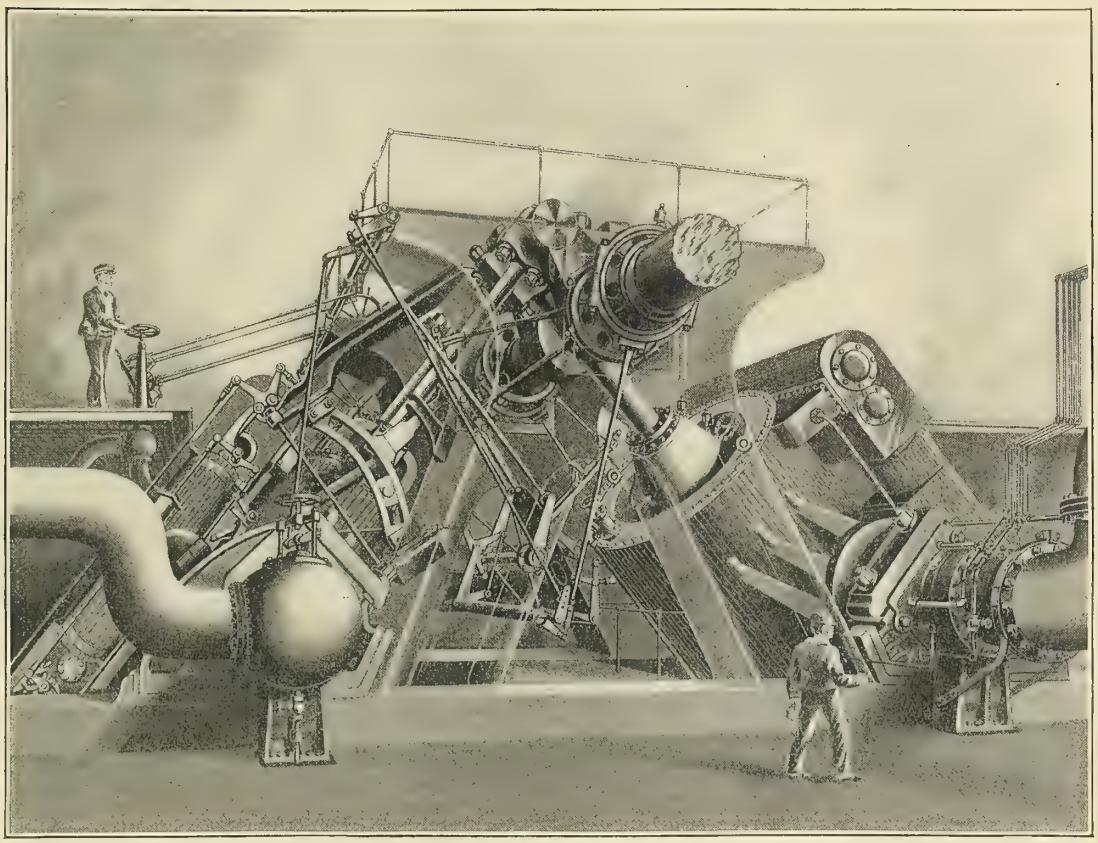
Total steam used in combustion..... 4.1 per cent.
Net water evaporated per lb. oil..... 14.1 lbs.
Total evaporation per square foot heating surface..5.9 "
Temperature of smokestack..... 419 deg. F.
" " air for combustion ..... 250 " "
" " oil ..... 136 " "

In a second test, when 983.8 pounds of oil were burned per hour, the total evaporation per pound of oil was 14.3, and the temperatures were: Smokestack, 485 degrees; air for combustion, 275 degrees; oil, 157 degrees.

Liquid Fuel.—The Oceanic Steamship Company and many other Pacific vessel owners are burning fuel oil on their steamers.

Engines of the Steamboat Connecticut.

The side wheel steamboat *Connecticut* is again in service on Long Island Sound, and for the last twelve months has been running between New York and Providence. Unusual interest is manifested in this boat because of the engines which are of the compound oscillating cylinder type. The *Connecticut* was built in 1889. For several years accidents to the machinery of a greater or less extent were met with, until, finally, one night while on a regular trip, one of the piston rods of the low pressure cylinder snapped off about four feet from the crank, and demolished the cylinder. The boat was laid up and not repaired until recently, when the contract was given to the W. and A. Fletcher Company, of Hoboken, N. J.



COMPOUND OSCILLATING ENGINES OF THE STEAMBOAT CONNECTICUT

The hull is of wood, built by Robert Palmer and Son, Noank, Conn., and the machinery was constructed by Wm. Cramp and Sons' Ship and Engine Building Company. The diameter of the high pressure cylinder is 56 inches, low pressure cylinder 104 inches, and the stroke is 132 inches. Steam is supplied by six gun boat boilers, at a pressure of 120 pounds per square inch.

In repairing the engines several important changes and improvements have been made, and the illustration on this page is of the engines as they are today. The two piston rods of the low pressure cylinder, which were in a plane perpendicular to those of the

high pressure rods, have been replaced by a single rod 16 1-2 inches in diameter, and the friction of the rod in the stuffing box is taken up by segmental staves of steel, Babbitt lined. The box is made steam tight by packing rings at the upper end. Water circulation is provided through the guide holders in the cylinder head.

Another defect in the engine was the side thrust of the cylinders, owing to the difference of steam pressure in the trunnions on the two sides of each cylinder. In rebuilding the engine this side thrust was taken up by introducing a ball bearing consisting of one hundred 2-inch hardened steel balls, running in hardened steel ball tracks. The trunnions are supported in adjustable quarter boxes of chilled cast iron, and provided with water circulation through annular holes extending lengthwise through the trunnion between the steam passage and bearing surface. Oil lubrication is secured on the bottom of the moving trunnions by holes in the quarter boxes and grooves in the moving bearing.

The valves on this engine are of the Wheelock grid-iron type, and permit of delicate adjustment. The small size of excentric rods, as seen in the engraving, shows how easily these valves are operated and what little power they require. The valves are located on the top of the cylinders, a steam and exhaust valve at either end. There is an independent cut-off gear for tripping the steam valves.

This style of engine is seldom seen in these waters, the only other vessel equipped with oscillating cylinders of this type being the freight steamer *Nashua*. In England and on the Continent oscillating engines were used extensively on channel and coast steamers, but in these cases the cylinders were generally mounted vertically below the shaft and worked on two cranks. The principal advantage of this type of engine is directness of application of the power by dispensing with the connecting rod, but it is questionable whether this advantage is not more than overweighed by the absorption of power required to oscillate these immense cylinders. The cut on the preceding page is reproduced from *Power*.

Repairing the Torpedo-boat Destroyer Salmon.

The British torpedo-boat destroyer *Salmon*, which was built by the Earl Company in 1895, and is one of the original fleet of 27-knot boats, was run into during the last winter by the channel steamer *Cambridge* during a heavy fog on the North Sea. The *Cambridge* struck the destroyer on the port side, almost amidships, and in order to save the crew the bow was kept in the indent made in the side of the destroyer. This indent was 5 feet deep and 8 feet broad in a fore and aft line, and was triangular in form, the apex being toward the bow of the destroyer. The plates of the destroyer were torn and twisted and the bow was displaced in a most remarkable manner. The main rent, which is shown in the illustration, extended down to the bilge, the shell plating being driven through the timbers into the boiler room. The bottom plating was buckled up athwartships, as well as in a longitudinal line, and the deck plating was twisted and bent. The starboard shell-plating was also buckled, the bow was driven out of line to the extent of 15 feet, listed to starboard to the extent of 5 inches in 12 feet, while the keel was from 6 inches amidships and 21 inches at the stem lower than the stern, which remained unaffected. Such a contortion in all three possible directions is unique.

The section of the *Salmon* is much the same as those of the destroyers building in this country. The shell-plates are 7 pounds per square foot and the sheer-strake stringer 9 1-2 pounds. The frames are 2 1-2 by 1 1-2 inches by 2 1-2 pounds angle bars, spaced 20 inches centers. Fore and after coal bunker bulkheads are on either side about 3 feet from the sides. These bulkheads are of 4 and 6 pound plating, stiffened by 1 1-2 by 1 1-2 inch by 1 1-2 pound angles. The beams are 2 1-2 by 1 1-2 inch by 2 1-2 pounds. The sheer-strake angle 2 by 2 inch by 3 1-2 pounds, and the double continuous longitudinal angles in the coal bunkers are 1 1-2 by 1 1-2 inch by 1 1-2 pounds.

THE WRECKED TORPEDO BOAT DESTROYER SALMON.

The vessel was brought into Harwich harbor and there beached and temporary repairs made to enable her to be towed to Ipswich, where, although there is no dock, a soft mud beach was available. At Ipswich further repairs were made to enable the boat to be towed to Sheerness dock yard, where she was finally repaired. Wooden planks were fitted over the rent and a deck stringer plate 3 feet 6 inches broad and about 24 feet long was laid. A sheer-strake or girder over 30 feet long and 4 feet 6 inches deep, with double angle bars at top and single bar at bottom, was riveted to the plating forward and aft of the fracture, and was also secured to the wooden planking and deck stringer plate. Four girders were placed in the bottom of the ship and the bottom skin plating was reinforced by a special plate.

Thus strengthened, the destroyer was towed to the dock yard by a wire hawser, which was placed around

the boat with a shackle at the bow, so that no strains would be brought on the forward structure. The steering of the boat was very difficult, owing to the swerving of the bow.

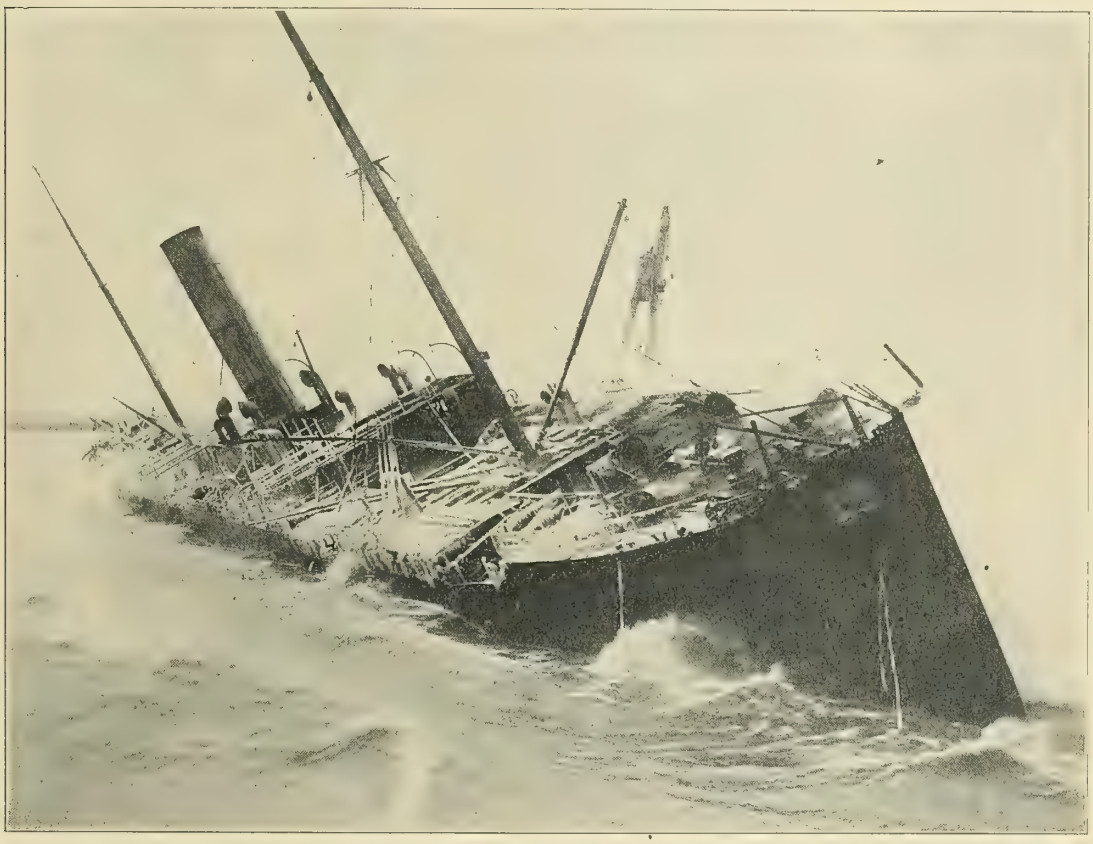
On arriving at Sheerness it was necessary to take the exact draft at many points along the keel, and the dock blocks were laid to suit this form. At the same time the usual keel blocks were set in the central line of the dock true to the ultimate line and level of the keel. Timbers were laid across the dock on which were built three cradles for carrying the bow. The ship was then cut completely in two and the fore body first brought into a true vertical line by shoring within the cradle, which was subsequently lifted above the level of the ordinary dock blocks by hydraulic jacks and then slipped over until the fore part of the hull was in line longitudinally with the after part. Due to the buckling of the plates, the over all length of the boat was 3 feet less than the original, and, therefore, the bow was drawn ahead this distance and finally lowered to the central dock blocks as originally prepared.

About 32 feet of the ship in the neighborhood of the rent was cut away and a new part built in. The boilers, which had received considerable damage, were repaired and the vessel given a general overhauling.

The above facts and accompanying illustration are taken from *Engineering*.

Burning of the Steamer British Queen.

A second Hoboken fire, more spectacular but not so disastrous as the one which occurred 21 months ago, broke out March 18th on the Phoenix Line pier, completely destroying that pier and seriously damaging the steamer *British Queen* and several lighters which were lying alongside. The fire broke out at night time on the river-end of the pier and fanned by a forty-mile gale of wind, quickly spread throughout the length of the shed and into the hold of the *British Queen* through her cargo ports. The crew and longshoremen aboard only saved their lives by jumping into the water and swimming to places of safety. Before the ship could be towed into the stream, fire had spread from stem to stern. Many tugs and fireboats came to the scene, but the most they could do was to prevent the flames from spreading to the adjoining property of the Holland-American Company.



STEAMER BRITISH QUEEN SUNK IN NEW YORK BAY.

The ship, enveloped in flames, was finally drawn into midstream and carried by the ebb-tide down the river to opposite Bay Ridge, where she grounded and sank. The burning barges, which were towed from the burning ship also started towards the Bay. Some of them striking the piers on the New York side, and, on Governor's Island, started small fires, which fortunately, however, were extinguished by the fireboats before serious damage resulted. The *British Queen* continued

to burn for many hours until her holds were flooded with water from the pumps of the wrecking boat moored near by. A large part of the cargo was made up of oil. The accompanying illustration shows the ship as she lay aground after the fire had been put out. She was built at Newcastle in 1890 and is 400 feet long, 47.2 feet beam and 28 feet deep. The pier was burned to the water's edge.

The origin of the fire is not known, but it was reported that it broke out among some boxes of cartridges stored on the pier which were to be shipped on the steamer to South America via Belgium.

Oil Fuel.—The first ship to cross the Atlantic with boilers burning oil fuel was the British tank steamer *Clam* owned by the Shell Trading and Transporting Co. which arrived in Philadelphia recently. Many vessels of this company are equipped for burning oil fuel. One of the advantages this system has over coal, which is not generally appreciated, is in the amount of fuel that can be supplied to the boilers. The human element comes so largely into play in the stokehold that the maximum speed of an ocean liner is frequently not attained because of the inability of the firemen to shovel enough coal through the furnace doors. Another advantage of this fuel is that the amount of oil can be absolutely regulated by the engineer. While this class of fuel is limited to a certain extent to ships plying between oil producing countries, yet the discovery of oil in Texas has greatly increased the world's supply and will reduce the cost of this fuel.

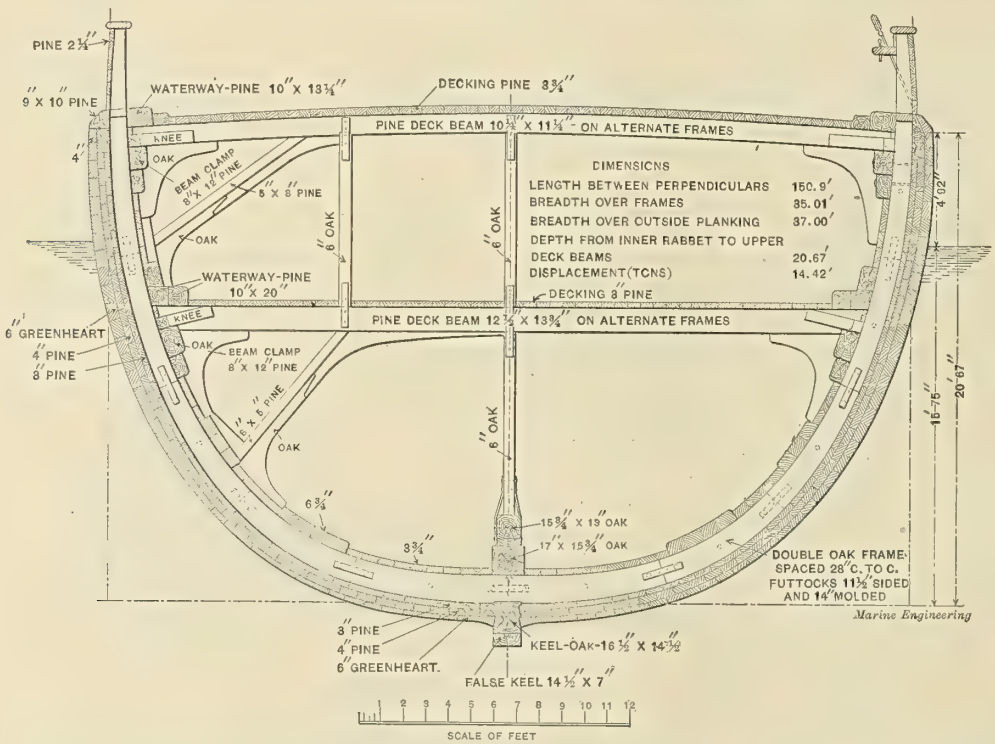
THE STEAM BARKENTINE GAUSS OF THE GERMAN ANTARCTIC EXPEDITION.

Designed and Built at the Howaldtswerke, Kiel, Germany.

BY GEORGE CROUSE COOK.

The present German Antarctic expedition is, as is well known, promoted by the German government and was officially authorized by an imperial decree addressed to the Chancellor of the State. This decree formally directed the object and duties of the expedition and appointed Dr. Erich von Drygalski, of the University of Berlin, to be the leader in the scientific work. The expedition, which left Germany early in August, 1901, will proceed first to the island of Kerguelen, where a magnetic and meteorological station will be established. It will then push south for the main object of exploring the Indo-Atlantic side of the South Polar Region and where a second scientific station will be established if suitable land is discovered. This station will be kept open for observation and study for at least one year, while the main body of the explorers will survey and map as much of the region as they are able to cover. The party will attempt to return with their ship either in the spring of 1903 or 1904, as the leader decides to be the more profitable.

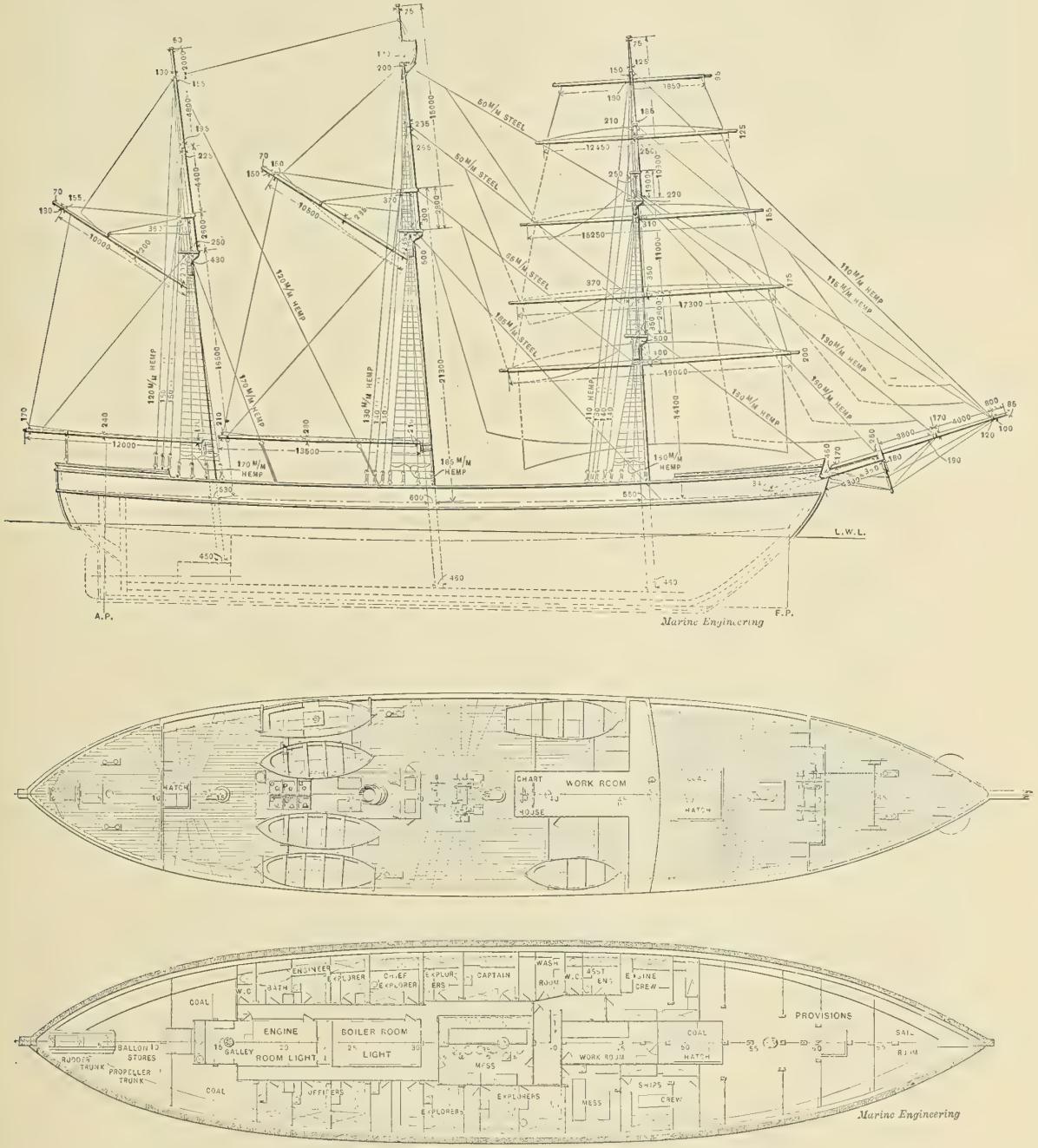
The brightest hopes are held for the complete success of the expedition, and no expense or care has been spared in supplying the best equipment and outfit that could be acquired. The ship was designed and built particularly for this expedition and the party may be said to have in the *Gauss* the finest vessel that has ever started on a similar service.



MIDSHIP SECTION OF BARKENTINE GAUSS

The leading features and dimensions of the vessel may be noted as follows: Length between perpendiculars, 150.9 feet; breadth over frames, 35.01 feet; breadth over the outside planking, 37 feet; depth from inner

The detailed characteristics of the construction and arrangement of this splendid vessel may be pointed out for their full appreciation, and each of the following points may be noted in the accompanying plans, which



SAIL PLAN AND DECK PLANS OF THE BARKENTINE GAUSS.

rabbet to upper deck beams, 20.67 feet; indicated horse power, 275; speed with 728 tons deadweight on board, 7 knots; total displacement in salt water, 1,442 tons. It will be understood that the odd decimals appearing in the figures are developed in the change from the metric system of measurement used in Germany.

are reproduced from the builder's drawings. In each feature of the design and construction the ruling idea was to advance the efficiency of the vessel for the object which it was to serve and a study of the following plans will show to what a high point this has been achieved.

As the form of the vessel was the first item to receive consideration in the design it will be well to give that the first notice. In the outline of the midship section the key to the whole design of the form may be seen, and it was so chosen to cause a vertical resultant in the compression of ice about the vessel which would tend to lift it bodily rather than crush in the sides. The same idea may be noted in the profile of the stem and stern which fall in below the water line, and, as far as possible, all projections which could possibly give a hold to the ice are cut away. In the general arrangement plan it may be seen that both the rudder and propeller may be drawn vertically up into trunks designed for the object, and thus preserved when surrounded and racked by ice. The removal of the rudder and propeller also serves to reduce the possible grip of the ice on the ship, which would prevent it from lifting. The rig used is that of the barkentine, or three-mast schooner as it is called in Germany, and one which stands commended for simplicity and efficiency in itself. The sail area is comparatively small, but necessarily so, for the severe conditions in which the vessel will serve. The masts and yards are strong and heavy, and steam winches are placed on the upper deck at convenient points for working the sheets and braces. Practically all the standing and running rigging is made up from hemp rope, as this can be handled with greater safety in intense cold than that made from steel wire.

The arrangement of the vessel has special reference to warmth and convenience. The accommodations for the officers and men are all placed in the 'tween decks, as may be seen on the plans. Separate cabins are prepared for scientists of the expedition and officers of the ship, but they have common mess and work rooms. The absence of side lights or ports will be noticed, and this leads to the feature of the arrangement which places the principal rooms, that is the mess and work room, in the center of the vessel, where they can be most conveniently lighted from overhead. The ends of the ship, both on the berth deck and in the hold, are filled with ship's stores and provisions, except aft on the berth deck, where a compartment is given up to the balloon and aeronauts' equipment, with which the expedition is supplied. In the hold a section of the space is taken up by the engine and boiler compartment, but the greater part is given over to the coal bunker, or rather the coal hold, which has a capacity of 340 tons. Additional coal is carried abreast the boiler room and on the berth deck, which gives a total supply of about 400 tons. A low poop and topgallant forecastle are built in on the line of the bulwark and give accommodation for the dogs and dog supplies carried by the expedition. On the upper deck amidships are two deck houses, the after one being merely the engine and boiler room casing carried up to form a short boat deck, and the forward being a chart house, work room and base for the navigating bridge. An additional steering wheel is fitted on the poop aft, and used principally when the vessel is under sail.

The construction of the craft is as strong and efficient as it could possibly be made. Oak and yellow pine are used throughout and probably in as large quantities as has ever been the case in a craft of equal size. This fact will be evident by a note of the midship section.

The outside skin of the vessel is particularly noteworthy, as it is made of three completely independent layers of planking. The two inner layers amidships are made up of yellow pine 3 inches and 4 inches thick respectively, but changed to oak of equal thickness at the ends. The outer layer is of selected Demerara greenheart, varying in thickness from 3 inches on the bottom to 6 inches at the water line, and is carried all fore and aft. A heavy coat of marine glue is laid between each layer of this planking and all the seams carefully calked.

Practically the only metal used in the construction of the vessel, outside of the connections and fastenings, is in the engine and boiler room bulkheads and casings, which are made up of steel plate and stiffened by steel angles in the usual manner.

While the main dependence of the vessel for propulsion is on the sails, the engine and boilers are capable of developing a speed of 7 knots per hour when steaming at full power. The engine is of the direct-acting, triple-expansion type, developing 275 I. H. P. when turning 130 revolutions per minute. The diameters of the cylinders are 12, 19 and 30 inches, and the stroke is 18 inches. Steam is supplied by two cylindrical fire tube boilers, each 7 feet in diameter and 9 feet 3 inches long. Each boiler is fitted with Morrison suspension furnace and carries a pressure of about 180 pounds.

All the living rooms of the vessel are steam heated by radiators of such size as to keep the temperature at + 10 degrees Centigrade when there is a temperature of — 30 degrees Centigrade outside. The vessel is also lighted throughout by electricity, and in these items the expedition is by far the best equipped that has ever sailed.

The equipment of the vessel is equally complete and satisfactory for the service. The usual equipment of anchors for a much larger craft is supplied, and, in addition, special ice anchors and much spare chain and hawsers. All the main sails, rigging, blocks, etc., are in duplicate, and a heavy awning is supplied to cover the entire upper deck. A complement of five boats and a naphtha launch are carried; each of these is completely equipped with masts, sails, water tanks, compass, etc.

The complement of men starting with the *Gauss* on this bold expedition, and with whom the success or failure so much lies, consists of eight explorers or leaders, four officers of the ship, three engineering officers, twenty men in the ship and engine crew, and a cook and steward. Each of these men was carefully chosen for his particular fitness in this work and, for some time before the expedition left Germany, was given special training in his duties.

Liquid Fuel.—Interesting trials in fuel oil burning have recently taken place on board the North German Lloyd Company's ship *Tanglin*. This steamer was lately chartered to convey Eskimo dogs and equipment to the German South Polar exhibition from Bremen to Kerguelen Island. On the homeward voyage the ship took 350 tons of Borneo oil at Singapore and from there to Bangkok burned 13 tons of oil a day. It is stated that if coal had been used 18 tons of British or 20 tons of Japanese coal would have been required to drive the ship at the same speed.

Oil Fuel.

We have frequently heard of late years the cry of warning because of the rapid consumption of available coal. Whereas the eventual destruction of the coal fields is a remote possibility, yet at present we now have opened up to us, through the discovery of the oil fields of Borneo and Texas, a supply of cheap liquid fuel that seems almost inexhaustible. For many years the great fields of the Alleghanies and Russia have supplied the world's demands for mineral oil for lubricating and illuminating purposes and for the various arts, but the supply has not been large enough to warrant oil being used generally as a fuel. In these two great fields of Borneo and Texas, located almost diametrically opposite on the earth's surface, with the auxiliary fields of Pennsylvania, California and Europe, we find sources of supply well located for the general distribution of oil. At present fleets of steamers are engaged in transporting the oil to the cities of the world, and the shipyards in this country are being filled up with orders for oil barges and steamers to further augment this fleet.

Oil is an ideal fuel for use on board ship, and the many experiments which are being carried on at present assure us that the difficulties of burning oil under a marine boiler will soon disappear. These experiments are being conducted by several companies independently of each other, and the reports received at present indicate that the success attained is so great that the companies are to equip more steamers with oil burners. It is stated that not less than fifty steamships have been fitted out with oil burners by a single English company. Two of the transatlantic lines, and many others traversing the Atlantic and Pacific, are also equipping their ships for this fuel.

The prejudices against oil as a fuel are thus disappearing in view of its many advantages. The relative heating value of oil and coal are about as 1.7 to 1 per unit of weight, and the space required for stowing a ton of oil is about 35 cubic feet in comparison to about 45 cubic feet for coal. The oil can be stored in the water bottom or ballast tanks of ships, thus occupying unavailable space, and throwing open for cargo space formerly occupied by the coal bunkers. The question of securing complete combustion has already been solved, so that no smoke nor soot are formed. On account of the lighter weight of oil per unit of heat the carrying capacity of a ship is also increased. The largest economy is found in the saving of labor, for with oil, not only are there no ashes to remove, but one competent fireman can perform the work of four or five men when coal is burned. In loading the oil, much less time is required than in loading coal, for the liquid can be taken on board in port through a hose from tank barges at the wharf, similarly to receiving fresh water supply.

It is difficult to compare the cost of the two kinds of fuel, owing to the several elements of labor in the stoke-hold and in loading, space saved, which would otherwise be devoted to cargo space, and first cost of the material. As to the latter item, with coal containing about 14,000 B. T. U., at $4 a ton, the cost of oil for the same amount of heat raising power would be about 90 cents per barrel of 42 gallons.

It is generally conceded that it is necessary to heat the oil before piping it to the burners. In former installations these heating coils were placed in the uptake, where they were subjected to a high temperature as a result of which carbon was deposited on the inside of the coil, and, in one or two instances, the coil eventually burned out and the oil flowed down into the boiler causing disastrous fires. Now, a temperature of 140 to 180 degrees for the oil seems to give the best results, and this heating is secured by coils placed in settling tanks through which exhaust steam is passed. To remove the water from the oil, two settling tanks are provided. The size of these tanks depends on the amount of water found in the oil; the percentage of water in Texas oil is very small and the tanks are therefore of a size sufficient to contain but three or four hours' supply. If the water is not removed and enters the burner it puts the flame out, and, when the oil enters again, it runs into the furnaces unconsumed and is liable to cause severe explosion.

Most of the appliances heretofore used have been adapted to the present type of Scotch boiler, and some of the burners have been so arranged that the furnace can be used for burning coal also. This does not appear to be good engineering, and we may look forward to the day when a new boiler will be brought out to meet the special requirements of oil fuel.

It appears to be the general belief that a large combustion space must be provided and that the gases should have direct contact with the plates of the boiler rather than having a brick lining intervene. There are many patented burners on the market, all with good points about them, but the greatest success seems to be found with the burners which use oil, and air or steam at a low pressure. The function of the burner is simply to divide the oil into a fine spray and mix it with the proper quantity of air for complete combustion. Satisfactory results have been attained with oil under about 20 pounds pressure and the air under 8 to 16 ounces pressure. The disadvantage of using steam for spraying the oil on board ship lies in the fact that larger evaporators must be supplied to make up the quantity of water used for the purpose of spraying, which varies from 2 to 10 per cent. of the total evaporation. The total power required for the air and steam blast will be found from about 5 to 15 per cent. of the power developed. The most successful experiments appear to have been made with hot air forced or induced-draft systems, such as the Howden, and Ellis and Eaves, where the entering air is first heated by the escaping gases.

Certain it seems that, with the large supplies of fuel oil and the many advantages of this kind of fuel, we shall soon find many of our steamers burning oil under the boilers.

Trial Trip of Shawmut.—On March 22d the steamship *Shawmut*, belonging to the Boston Steamship Company and built by the Maryland Steel Company, was given a light draft trial. A speed of 14.78 knots was maintained, draft forward being 12 feet and that aft 18 feet, displacement 8,440 tons. The twin-screw engines making 95 revolutions per minute, developed about 5,000 horse power. A complete description of this ship was given in Marine Engineering of January, 1902.

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THE request which the contractors building torpedo vessels for the Government have recently made regarding an increase of 40 per cent. in the contract price, is one which the Navy Department will perhaps hardly find authority for granting, without special legislation from Congress, but we believe that the attitude of the Department will be generous regarding the matter, and if brought to the attention of Congress, as it probably will, we trust that it may receive favorable consideration and that such additions to the price for these boats will be made as may seem fair to both parties to the contract, having in view all the circumstances of the case.

It is an unusual request, but the situation is unusual and we believe justifies the departure from the usual policy in such matters. In 1898, when Congress appropriated the money for these sixteen destroyers and twelve torpedo boats, it was specifically provided that not more than five destroyers or four torpedo boats should be built by any one contractor. The obvious purpose of Congress was to distribute the work among the different shipyards and to stimulate and foster the investment of money and skill in the equipment of such engineering plants as should be able to do work of this high character. It must at the same time be admitted that the number of establishments capable of doing such work at that time was very small, and we should also remember the highly specialized character of the work on vessels of this description, and the admitted fact that of all classes of marine design and construction it is one where the attainment of the highest results necessarily calls for previous experience with work of this character, together with the highest technical and constructive skill in utilizing the results of such experience and in carrying out the work itself. Having in view these facts it was manifestly too much to expect that establishments without experience, with neither a technical nor operative staff trained in work of this character, should be able off-hand to achieve the advanced results aimed at and fulfill the difficult specifications supplied by the Government, especially within the limits of cost fixed.

The report of a special Board of Naval Officers appointed to investigate the condition of these boats has been made public, and we presume is familiar to our readers. The chief points may be summarized as follows:

With scarce an exception the boats will be overweight to a varying extent, but in many cases as much as 40 tons or upward. Few will be able to attain the speed anticipated. In some cases the structure of the boat is manifestly weak. In many cases excessive vibrations appear at high speeds, due to poor balance in the engines and to weakness of hull. In a general way, the destroyers will be more satisfactory and serviceable than the torpedo boats. Of the latter, while some are likely to prove good boats of their class, others seem likely to prove flat failures. Having in view the points referred to above, is this general result really surprising? Looking at the situation with the benefit of experience, is it not what we might have expected, having in view all the circumstances of the case? In fact it is probably not too much to say that there have not been lacking some who have foreseen this result from the first. Whatever may have been the causes that have led to the present situation regarding these boats, however, we believe that we should now look at the present and to the future rather than the past. A condition exists. Whether Congress or the Navy Department or the individual contractor is the more responsible for the condition, is a question

which we do not believe should be pressed, especially in view of the admitted fact that all have undoubtedly been honestly working for the accomplishment of the purpose intended.

The facts of present importance are these:

The construction of the present boats has been a school of training for the contractors, and the experience and benefit which they have derived are, of course, undoubted. In consequence there now exists in the United States, for the design and construction of boats of this character, a store of potential ability and capacity immeasurably beyond that available in 1898. This fact is indisputable. Now, in the broad sense, which profits the more by reason of the existence of such potential capacity? Undoubtedly the Government as representing the interests of the nation at large. Since, therefore, the Government profits the more, and since such experience and such potential capacity could have been gained in perhaps no other way, it seems only fair that the Government should pay. We believe, furthermore, that it is worth all it will cost. The capacity to improve on the past, the capacity to build boats of this type which shall be improvements on those now approaching completion, could have been acquired by no other mode of procedure than that which has been followed; and while the results may not be altogether satisfactory as regards the present output, the capacity for improvement in the present and immediate future is the result of chief importance. And since this is far more to the advantage of the Government that the private contractor, we believe that a wise and just policy on the part of the Government will dictate a generous treatment of the contractors, and we trust that a measure of relief may be passed which will fairly reimburse them for the part which they have thus taken in upbuilding the capacity of our country for the production of ships and munitions of war.

THE question of oil fuel on shipboard seems to be attracting increasing attention at the present time. The entry into the market of the Texas and Borneo supplies in relatively recent times puts a somewhat different aspect on the question of the use of oil for fuel purposes. Regarding the possibilities of such use from the engineering point of view, there has been no doubt from the very first. Such difficulties as have arisen have had reference solely to matters of detail, and in no important fundamental point has the use of oil presented any serious difficulty. The question has been very largely a commercial one. With most of the supply in sight spoken for in other branches of industry and for other purposes where more could be obtained for it than by its use as fuel, it was very uncertain where the price of oil would go if there should suddenly arise large demands for fuel purposes. With new supplies available, however, and with a reasonable probability of a price for oil which will enable it to compete with or even outclass coal, it is not surprising that renewed attention should be given to the engineering details relating to its successful use.

In the various systems and methods for burning oil in use or proposed, the following seem to be the essential items: (1) Settling tanks which will allow the small amount of water to separate and sink to the bottom where it may be drawn off as occasion requires. (2) Suitable burners for bringing about the proper conditions for the perfect combustion of the oil. (3) Suitable protection for the furnace sheets against the direct action of the impinging flame.

The greatest variety exists in the nature of the burners and in the methods employed for the perfection of the combustion. In a general way, however, these methods fall under two groups: Those which introduce the liquid as a spray atomized by steam or compressed air or both, and those which seek to first vaporize the oil and introduce it as a vapor. In both cases it is to be presumed that the substance burns as a vapor. The real difference in the two systems would seem to consist in this, that in one a liquid spray is introduced which almost instantly flashes into vapor and then ignites, while in the other the change into vapor takes place outside the furnace, whence it is then introduced, mixed with air, and ignited. Higher efficiency of combustion has been claimed for the latter system. This, however, is very largely a question of air supply in proper amount and thoroughly mixed with the spray or vapor. Heating the air is found to be an important feature in modern systems. This follows the analogy of hot draft in general, and a hot blast is also much more efficient as a vaporizer than a cold blast. To close with a word of advice, the progressive marine engineer will do well to keep his eye on the modern developments relating to the use of oil as a fuel.

MISHAPS AND REPAIRS.

Engine Breakdown.

A few years ago I saw a breakdown on a small steamer, an account of the makeshift repairs to which may probably prove interesting to your readers. The *T*—— was a small steamer with a two-cylinder compound engine, the cylinders being 15 and 30 inches in diameter and 24 inches stroke. A new boiler had just been put in and the pressure increased from 70 to 85 pounds, and the vessel was making her second voyage. Everything had gone very comfortably until we were about 350 miles from our destination. The second engineer had just relieved the chief at midnight and was just taking his customary look around when a terrible jar and a jerk somewhere aft gave notice that something had gone wrong.

It was the work of a moment for him to jump to the throttle and shut off steam, but too late, for with a shower of sparks the low pressure crankpin broke close to the forward web of the crank. The captain was immediately notified and the boiler made safe. The chief, who had returned to the engine room, now took a hand lamp and proceeded to investigate the cause and extent of the damage. It was found that three of the four bolts in the after coupling had sheared off and the forward part of the shaft had turned around the remaining bolt, bending the shaft and breaking the keeper bolts of both the spring bearing and the after main journals, in addition to bending the low pressure eccentric rods and breaking the after crankpin. After realizing the full extent of the wreck it became a question of how we were to reach port. We had a valuable cargo of a perishable nature, and of course every hour's delay was calculated to make things worse.

The engine, as I have already said, was an ordinary two-cylinder compound with balanced cranks. The air pump was driven from the L. P. crosshead; the circulating pump was an independent centrifugal pump and the feed and bilge pumps were driven from a disc on the forward end of the shaft. The valve gear was the ordinary link motion with the slide valves on the forward and after ends of the engine, the cylinders being side by side. The first suggestion was to drill a hole through the broken crankpin and put a bolt through and rivet it over. But this proposal was summarily settled by the remark that there was neither ratchet nor drill on board. In fact a few chisels, a couple of files and a really good set of taps and ties were the only tools on board. It was then decided to try and fix things up and run home with the L. P. engine. Three bolts were made out of a big slice bar for the after coupling. Threads were cut on both ends and the old nuts used and three nuts we stole off the foundation bolts. The bolts out of the forward and center journals were taken to replace those broken in the after journal and spring bearing.

The H. P. engine was stripped, the rods being lashed to the columns out of the way. The forward part of the shaft was lifted and the brasses taken from under to allow it to slide forward out of the way. It was then forced forward and secured with wooden wedges. The H. P. piston was secured at the bottom of the cylinder and the H. P. valve taken out and the bottom port stopped with some sheet gum and wedges, after which the steam chest cover was replaced. The L. P. eccentric rods were taken down, heated in the furnace and straightened and then put up again. All being now fixed but the broken crankpin, that was taken in hand. It was broken with a pretty clean straight break about a quarter of an inch from the forward web of the crank. We stripped the brasses off and rounded the edges of the break nicely with a file and then put it together again and were ready to turn over with the turning gear. Upon turning over we found the bent shaft was going to give further trouble, but we got over that by putting two strong shores from the top of the after journal under the bottom of the cylinder and lashing them secure, and then slacking up on the foundation bolts so that the whole thing could accommodate itself to the slight vagaries of the shaft.

We were now ready with the exception of the feed pump, and that we decided we could dispense with, letting the air pump discharge into the bilge and pumping from the bilge to the boiler with the donkey pump. So we got steam to 30 pounds and prepared to make a start. The chief took the throttle and had her pretty well warmed up. We then turned her just over the top center and removed the turning bar and gave the word "All clear." He gave her the steam with a jerk, but she only went to the bottom and there stuck. This process was repeated perhaps a dozen times with the same result, until at last the chief got disgusted and gave it up, telling the second to try what he could do. The second had been around "one legged jobs" before. He had her turned just off the bottom and began to lift her nearly to the top with a little steam and then pushing her down again until she began to form a little vacuum. Then he gave her the steam and over she went, and we were away after twenty-six hours of incessant work. The old engine walked all over the engine room every revolution, but she kept going. We reached home without further mishap, only stopping occasionally to let up on the coupling bolts. We made about 4 knots per hour and docked the vessel without any assistance. And now comes the aftermath.

The insurance companies made the captain a very substantial present for bringing his ship home without assistance, and the owner "fired" the chief and second engineers for letting her break down. But then, they were only a pair of "shovels," so what could you expect?

D. E. F.

Auxiliary Machinery Mishaps.

One very rarely hears or reads of breakdowns that do not directly concern either the main engines, the gear connected thereto, or the boilers supplying them with their power. Are we, accordingly, to infer that mishaps to the hundred-and-one auxiliaries are so insignificant that they are not worth recording, or that they never occur at all? I do not think that any sea-going engineer who has been so fortunate—or perhaps so unfortunate—as to put in some of his time on a modern transatlantic greyhound would answer this question otherwise than by an emphatic negative. The present system of fitting up the engine room with as many in-

dependent units as possible minimizes the chances of a general breakdown, but it multiplies chances for individual troubles, and it is rare that any single pump or engine can go out of business without making its effect felt throughout the whole system, thus influencing to a greater or less extent, the "pulse" of the entire department, the "turns."

gine, but it was quite as apt to be a main-feed pump, or a circulating centrifugal, or even one of the air pumps, between which and the circulators there was naturally a strong bond of the "sympathetic strike" nature.

This vessel was fitted with Howden's system of forced draught. The fans were direct-connected to the

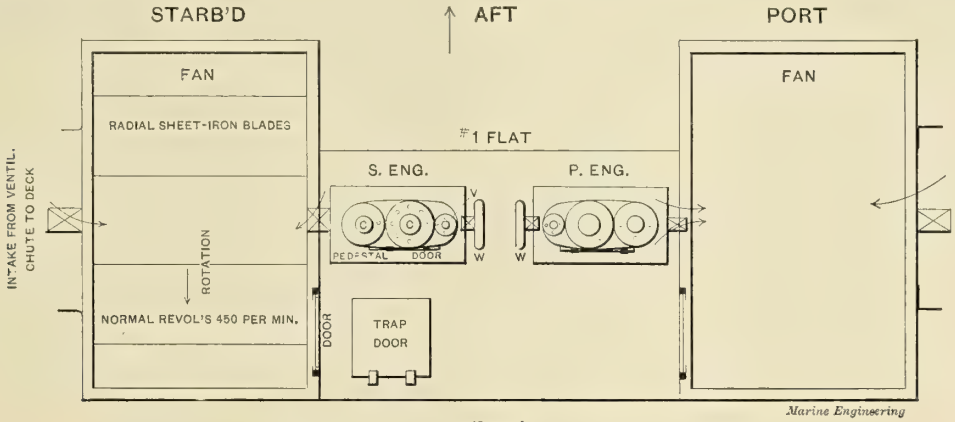


Fig. 1

The writer spent some months on a liner whose daily runs averaged not far from the 500-mile stretch. She was twin-screw, and her engines developed over 20,000 I. H. P. at about 90 revolutions. There was absolutely no attached gear of any description, and I only knew of

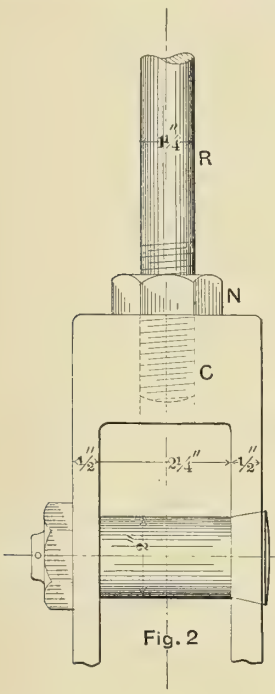


Fig. 2

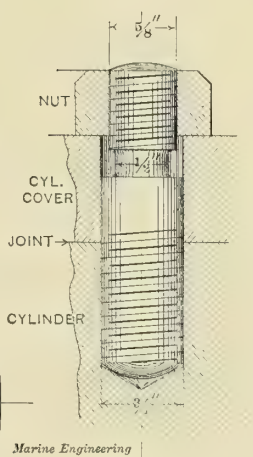


Fig. 3

her main engines stopping at sea for accident but once in over a year, and then only to tighten up a nut on the after-end of a link quadrant, and the job took not more than a minute. But there was never a trip, and seldom a watch, when the "turns" were not cut down more or less by trouble with one or frequently with several of the numerous auxiliaries. Very often it was a fan engines, and were supposed to be run not over 450 revolutions to the minute. The engines were heavy, upright, 2-cylinder machines, cranks 180° apart, with water-tight casings around the cranks and rods, running in a bath of engine oil and fresh water. In a cool and open place where they could have been readily and carefully inspected, I believe they would have given very little trouble; but situated as they were, they did not get quite the same solicitous care that was lavished

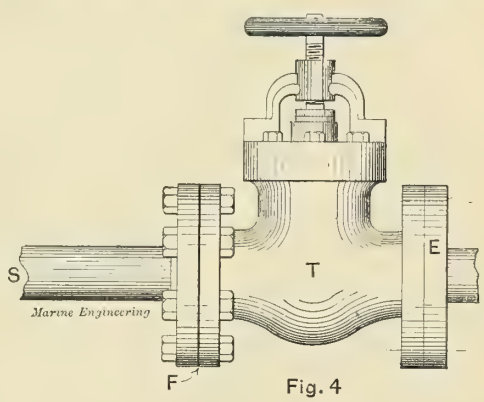


Fig. 4

on the gear in the engine room, and they took their revenge. They were located in small box-like rooms directly over the ends of the boilers amidships (see Fig. 1). The temperature in some of these rooms, or "flats," as we called them, was around 160 degrees F. with both fans running. With one stopped it ran up 20 degrees or so higher, and with both out of commission the place was unbearable and the carbonized grease around the engines frequently ignited and drove away the most fireproof of the staff till the stuff had burned away.

One of the favorite breaks was as follows: The piston rod *R* (Fig. 2) screwed into the cross-head *C* far enough to get the clearance right, and was then locked in place

with the nut *N*. This nut was always hammered up hard, but the vibration of the engine frequently caused it to slack back. The rod would then screw itself out by degrees, and soon the piston would be banging away at the cylinder-head. If anybody happened along about this time, the thing would be caught in time; if not it was only a question of minutes till the six studs gave way, and generally a few pieces of cylinder flange and walls as well. Then there was a nice, warm job on. The stock method of making this repair was to replace the head on a piece of thick asbestos joint, having put the broken pieces of cylinder back with plenty of red-lead putty. Then a block of wood was placed on the head, with a screw-jack top of that, bearing against the steel beam passing overhead, and shored down hard.

But this pro-tem method did not obviate the necessity of getting a new cylinder the next time in port, and as both cylinders and their common valve-chest were cast in one piece the smash was rather expensive. To this was due an improvement which shortly made its appearance, and while it did not lessen the chance of breakdown, made the repair much quicker and almost entirely did away with the chance of injury to the cylinder flanges. This was a stud, made as in Fig. 3. The necked-in portion was quite strong enough for the strain of normal running, but broke promptly under a blow from the piston, leaving a stump large enough to be easily gripped and removed with a Stillson wrench.

Of course we carried numerous spare cross-heads, brasses, pistons and rods, valves, and valve-spindles, eccentric straps, etc., and we needed them all. On one occasion, when a large portion of the casing was shattered by the connecting rod breaking way from its crank-pin bolts, a water-tight patch was fitted and bolted on, a piece of ribbed floor-plate being borrowed from back of the port engine for the purpose. I have seen other holes in the casings plugged and patched in most original and ingenious ways, utilizing everything from carpenters' wedges to spare zincs for the boilers, and more than once has a stout wooden plug, bolted or shored down, done yeoman service as a cylinder cover. The small flywheels shown at *W* in Fig. 1 disappeared in time and a cap was put on the end of the main bearing, preventing the leaking of the "slush" in the casing. And last, but not least, I have learned recently that so far as the fan engines are concerned this ship has become the proverbial "home," all due to a little wrinkle of the chief's.

It seems the principal cause of all the trouble was laid to excessive speed for the engines. They took their steam from the main boilers (200 pounds) through a reducing-valve at 120 pounds. When cleaning fires, steam generally fell to 185 or even lower. This meant a corresponding reduction of auxiliary steam and a consequent slowing of the fans at the very time they were most needed. Sometimes it was noticed that the steam on the fans did not fall in the same ratio as the main steam; and when the main steam went up again the auxiliary steam went up too, and also the speed of the fans. This meant lots of revolutions, so dear to the heart of the folks on watch—till a fan gave out somewhere out in the stokehold, and down came the steam again. As the reducing-valve was evidently the prime culprit, it was decided to trust it no longer, and the "Old Man's" scheme was put into execution. In Fig. 4, *T* is the throttle-valve to the engine, bolted on the valve-flange at *E*. *S* is the steam to the engine. At *F* was inserted a blank-flange of stout sheet metal, with a hole 1 inch in diameter in its center and thus considerably smaller than the pipe, though I have forgotten the exact size of the latter. This solved the whole trouble, simple though it seems, and so far as I can learn has not added any hours to the length of the voyage. The cry of "Port No. 1 gone up through the deck!" is now about as rare as "Man overboard!" while the boys off watch go quietly ahead with their pipes, their "7854," or their *Marine Engineering*, and stow their boiler suits and their brogans away in full confidence that they won't be wanted for eight long hours.

THEOR.

LAUNCHES.

Steamer Alice M. Jacobs.—The new fishing steamer *Alice M. Jacobs*, built for Capt. Sol. Jacobs, of Gloucester, Mass., was launched from the yard of Arthur D. Story, at Essex, on March 11th. This craft is built especially for fishing industry on the New England coast.

The principal dimensions are: Length over all, 141 feet 7 inches; beam over plank, 24 feet; depth, 12 feet; draft, 10 feet 4 inches.

Her keel, stem and stern post are of white oak; the frames are of white oak and hackmatack; the outboard plank and ceiling are of yellow pine, and the deck is of white pine. She will have a very large and roomy forecastle and galley, with ample accommodations for a crew of twenty-six men. From the after forecastle bulkhead to the machinery bulkhead is the main hold, about 50 feet long. It will be fitted up with bins, etc., for the stowage of ice, fish and stores in the most complete manner. Abaft the machinery space is the cabin with accommodations for the officers. She will be fitted to carry 40 tons of ice and the usual gear, boats, etc., of the most complete modern fisherman.

There will be about 35 tons of ballast, part of it being cement and iron punchings between the frames, and the remainder pig iron, stowed about the keelson.

The main engines are light and compact and of the vertical inverted compound type, with cylinders 18 inches and 28 inches in diameter, by 18-inch stroke and capable of developing 300 indicated horsepower. The cranks are set at an angle of 90 degrees. The main valves are of the piston type. There is a surface condenser with 600 square feet of cooling surface; air and circulating pump, feed pump and bilge pump, all independent, with inspirator and ejector. Steam will be supplied by two Almy water tube boilers, the breeching from which connects with a smokestack 25 feet high above the deck. It is fitted with a hinge so that it may be lowered to the deck when under sail. The working pressure is to be 150 pounds per square inch. The propeller is to be of cast iron with four blades. There is to be a steam windlass and a steam hoister. The owner also has under consideration the installation of an electric plant and a refrigerating plant. There are fresh water tanks with a capacity of about 3,500 gallons of water.

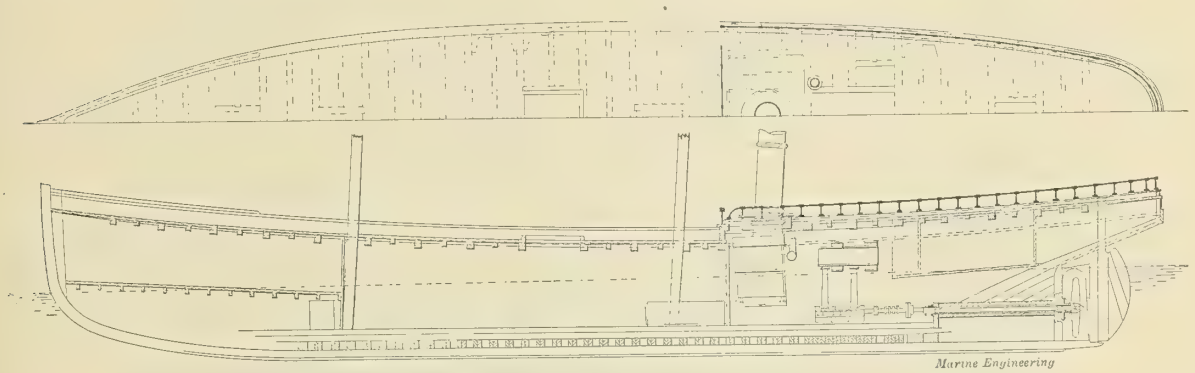
She was designed by Richard F. and William T. Keough, East Boston, the hull being built by A. D. Storey, Essex, and the machinery by Bertelsen and Peterson, East Boston.

Steamer G. J. Grammer.—The first winter launching to occur in Superior yards for several years took place on January 18th, when the steel steamer, *G. J. Grammer*, built to the order of the Seither Transit Company, of Cleveland, was launched. The vessel is 366 feet in length, 48 feet beam, 28 feet deep, and was built for the ore trade.

Steamship Columbia. — The steamship *Columbia*, for the Anchor line service between Glasgow and New York, was recently launched on the Clyde. The new steamer is 500 feet length over all, 56 feet molded breadth, 36 feet deep, with a gross tonnage of 4,800 tons and at load draft the displacement will be about 15,000 tons. The ship has handsome accommodations for the three classes of passengers. There are staterooms for 216 first-class passengers on the main and bridge decks luxuriously fitted up.

Steamer Etruria.—On February 8th the steamer *Etruria* was successfully launched from the West Bay City (Mich.) Shipyard. She is owned by the Hawgood Transit Company, of Cleveland, and is a single deck freighter. The dimensions are 434 feet length over all, 50 feet beam, 28 feet depth. Steam is supplied by two Scotch boilers 13 feet 2 inches in diameter, and 11 feet 6 inches long, and fitted with Ellis and Eaves induced draft. The engine is a triple expansion with cylinders 22, 35, 58 inches in diameter by 42 inches stroke.

Steamer W. H. Gratwick.—On February 1st there was launched from the Cleveland yards of the American Ship Building Company the steamer *W. H. Gratwick*, which is 436 feet long over all, 50 feet beam, 28 feet molded depth. Her carrying capacity is 6,200 gross tons of ore on 18 feet draft. The ship will have triple expansion engines, with cylinders 22, 35 and 58 inches in diameter by 40 inches stroke. Steam will be supplied by two Scotch boilers, 13 feet 2 inches in diameter and 11 feet 6 inches long, allowed to carry steam 170 pounds pressure.



FISHING SCHOONER ALICE M. JACOBS.

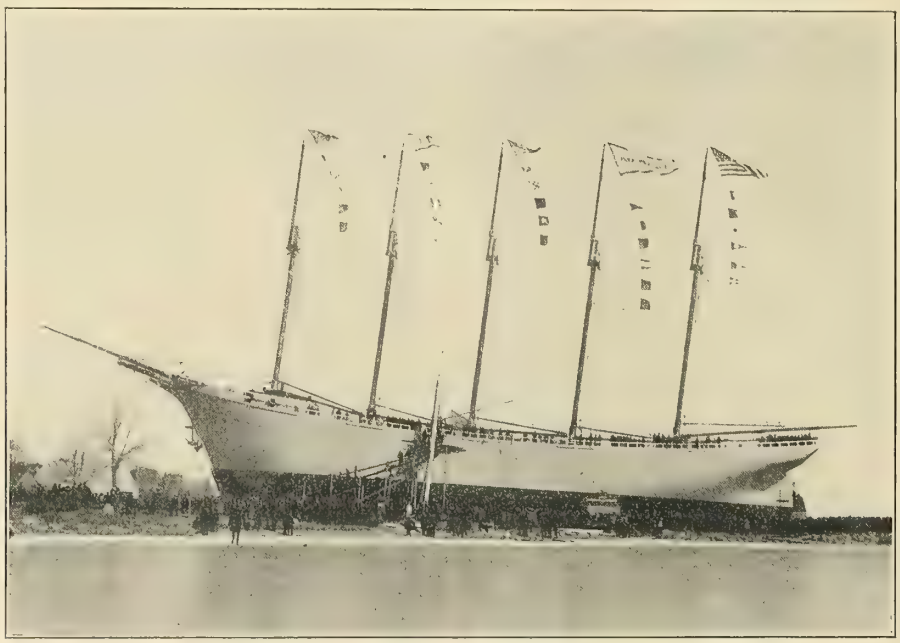
Steamship Hanoverian.—The steamship *Hanoverian* was recently launched from the Tyne for the Leyland line. She is built for the New York and Liverpool service and is of the following dimensions: Length over all, 601 feet; beam, 60 feet 3 inches; depth, molded, 42 1-2 feet; carrying capacity, 13,700 tons. The capacity of the water bottom is 1,650 tons and of the deep ballast tanks 3,500 tons. The vessel has accommodations for 245 cabin passengers in the bridge house amidships.

Steamer City of Memphis.—The steamship *City of Memphis*, for the Ocean Steamship Company, was recently launched from Roach's Shipyard, Chester, Pa. The ship is of the following dimensions: Length over all, 395 feet; beam, 49 feet; depth, 27 feet. The vessel is of steel throughout, with double bottom the entire length, and is of the hurricane three deck type. The ship is primarily for the carrying of freight, but there are accommodations on the hurricane deck for fifty first class passengers. The propelling machinery consists of a three cylinder triple expansion engine, with cylinders 28, 46 and 75 inches in diameter, with a common stroke of 48 inches. Four Scotch boilers, 15 feet in diameter, supply steam at 180 pounds pressure.

Steamer W. W. Brown.—The steamer *W. W. Brown*, second of six freight steamers being built for the United States Transportation Company, was launched from the yards of the South Chicago Ship Building Company on February 1st. The vessel will be 366 feet long over all, 340 feet between perpendiculars, 48 feet beam and 28 feet depth, and will cost $220,000.

Steamboat William G. Payne.—On February 8th, the steamboat *William G. Payne*, built for the New York and Bridgeport line, was launched from the yard of Harlan and Hollingsworth Company, Wilmington, Del. The general dimensions of the *Payne* are: Length over all, 257 feet; on water line, 240 feet; beam at water line, 36 feet 10 inches; depth molded, 14 feet 6 inches; draft, 8 feet. She is intended for day service on Long Island Sound, and can accommodate 1,800 passengers. A compound, inclined cylinder, direct acting engine is installed, with cylinders 35 and 72 inches in diameter and a stroke of 72 inches, driving feathering paddle wheels 19 feet diameter with nine buckets, 10 feet 6 inches long. Four Scotch boilers, 10 feet 6 inches long and 12 feet in diameter, built for the pressure of 140 pounds, will furnish steam.

Schooner Jennie R. Dubois.—On the 11th day of February, there was launched at the yard of the Holmes Ship Building Company, West Mystic, Conn., the five-masted schooner *Jennie R. Dubois*, built for the Sutton fleet, and to be commanded by Capt. E H. Smeed, of Providence, R. I. The measurements of this vessel are: Over all, 249 feet; depth, 26 feet; breadth, 46 feet; net tonnage, 1,942, and gross tonnage, 2,227. She is capable of carrying in her holds over 3,500 tons of coal, and could carry more than 2,000,000 feet of lumber. She has three full decks, the holds being respectively 12, 8 and 16 feet in depth, four cargo hatches and three deck houses. The forward deck house, which is 22x23 feet, is used for an engine room and forecastle, the midship deck house is 14x17 feet, and contains the cook's galley and stateroom and the second officer's quarters, and the after deck house, 33x28 feet, is divided into several rooms, containing the captain's stateroom and quarters, and also spare staterooms, bath and toilet rooms. The ground tackle for this vessel consists of one patent Baldt stockless anchor, weighing 7,250 pounds, and one ordinary anchor of 6,000 pounds. The windlass for hauling the anchors and chains was made by the Hyde Windlass Company. The engine is a thirty horse-power, and so arranged that it can be used for hoisting the cargo when desired. She is well arranged with all the most modern facilities for the handling of cargoes. There are three powerful wrecking pumps on board, one 6 inch, one 4 inch and one pair of Adair steam pumps, which, together, are capable of throwing from 6,000 to 8,000 gallons of water per minute.



SCHOONER JENNIE R. DUBOIS

Steam Yacht Quickstep.—On March 10th the composite constructed steam yacht *Quickstep*, built for Fred Grinnell, Fairhaven, Mass., was launched from Herreshoff's yard at Bristol, R. I. Length over all is 122 feet; on water line, 104 feet; beam, 18 feet; contract speed, 15 knots.

Steam Yacht Turbese. — There was recently launched from the Greenport Basin and Construction Company, at Greenport, N. Y., the handsome steam yacht *Turbese*, for Mr. A. Schwartzman, of New York. The general dimensions are: Length over all, 145 feet; on water line, 122 feet; beam, 17 feet 6 inches; draft, 7 feet 3 inches. She is built of wood throughout.

Steam Yacht Rheclair.—There was recently launched at the Burlee Dry Dock Company, Port Richmond, S. I., the steam yacht *Rheclair*. She is of the following dimensions: Length over all, 215 feet; on water line, 183 feet; beam, 27 feet; depth to main deck 13 feet. The yacht was designed by Messrs. Tams, Lamoine and Crane, New York city, for Mr. D. G. Reed.

Steamer Berkeley.—On March 7th the steamer *Berkeley*, of the Old Dominion Steamship Company, was launched from the yard of Wm. R. Trigg Company, Richmond, Va. The *Berkeley* is for night service on the James River between Richmond and Norfolk, is 213 feet long, 36 feet beam, 17 feet deep and will carry 500 tons cargo on a draft of 12 feet. There are accommodations for 54 first-class and 48 steerage passengers.

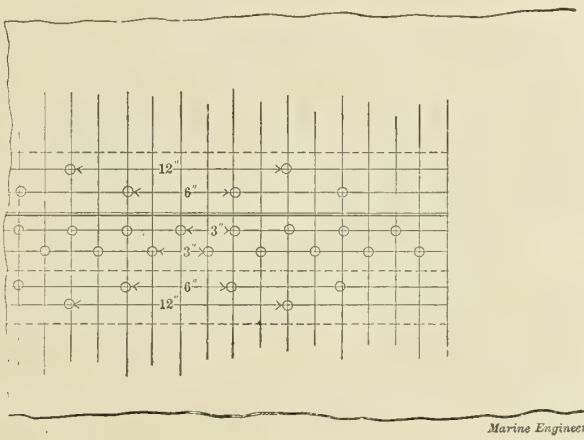
Steam Yacht Noma.—Messrs. Tams, Lemoine and Crane are the designers of the steam yacht *Noma*, which was launched recently at the Burlee Dry Dock Company, Port Richmond, S. I., built to the order of Mr. W. B. Leeds. The ship is of steel, twin screw, and of the following dimensions: Length over all 263 feet; on water line, 226 feet; beam molded, 28 feet 6 inches; draft, 14 feet. Triple expansion engines are designed to develop 4,000 horse power. They are of the four cylinder type, 17, 27, 32 and 32 inches in diameter by 24-inch stroke. Six water tube boilers will supply steam. The guaranteed speed is 18½ knots.

QUERIES AND ANSWERS.

Q.—A boiler is 54 inches in diameter, 5-16 inch sheets, 50,000 pounds T. S., with a lap joint and a strap on the inside, same thickness as shell, 3-4 inch rivets pitched 3 inches, 6 inches and 12 inches. The joint is just the same as a common lap joint double-riveted, with rivets pitched 3 inches, except that there is a strap on the inside of this joint, as shown in the sketch, and two rows of rivets on each side, the second row pitched 6 inches and the third row 12 inches.

I would like to know how many shear there are in 3 inches and how many in 6 inches, and how much strength this strap adds to the joint, and how to find it. J. T. F.

A.—It should be understood that the figuring of joints like these is very much a matter of judgment. Regarding the number of sections in shear you can easily count up that in 12 inches there are, reckoning on one side, three sections in single shear and eight in double shear, while on the other side all eleven are in single shear. Since this would then be the weaker side we may take the eleven sections 13-16 inch diameter. This gives 11 x .5184 = 5.70 inch. This at 40,000 pounds would give 228,000 pounds as the strength in shear for 12 inches of the joint.



LAP JOINT OF BOILER.

For the plate we have an area 5-16 x 12 = 3.75 inches. This at 50,000 gives 187,000 pounds. This shows that the shearing strength of the rivets is therefore greater than the tensile strength of the corresponding original or full section of plate, and therefore that there is an excess of rivet section in the joint.

If the row of rivets spaced 12 inches were omitted we should have in 6 inches five sections in shear. This would give in the same way as above, a shearing strength of 103,880 pounds. The corresponding plate strength would be 5-16 x 6 x 50,000= 93,750. This shows that even with the outer row omitted there is still an excess of rivet section.

Turning now to the plate the question of the efficiency and of the strength so far as the plate is concerned depends solely on where we may expect the plate to rupture. If, for example, it could be expected that rupture could be kept to the outer row of rivets spaced 12 inches, then the efficiency would become (12—13-16) ÷ 12 = 93 per cent. This, however, is out of the question, and, in the opinion of the writer, the very most that could be done would be to keep the fracture, perhaps, along the row spaced 6 inches. This would give an efficiency (6—13-16) ÷ 6 = .86.

If the strap were not there, the joint becomes a plain double riveted lap. In 3 inches there are two sections in shear giving a shearing strength of 41,472 pounds. The corresponding section of plate has a strength of (3 — 13-16) x (5-16) x 50,000 = 34,000. This again shows an excess of rivet section. The real strength is therefore that of the plate. For the plate we have an efficiency (3—13-16) ÷ 3 = 73 per cent.

It appears, therefore, that without the strap and as a plain lap joint the efficiency will be about 73 per cent. With the strap this becomes raised possibly to 86, though this might be considered as more than probabilities would warrant.

Q.—Will you kindly give me a thorough and accurate rule for working the horse power of a boiler of the following dimensions:—

Diameter of boiler	54 inches
Length of shell	84 "
Diameter of furnace	26 "
Length of furnace and tubes	70 "
Diameter of tubes	2 "
Number of tubes	80 "
Sq. ft. heating surface	284 "
Length of grates	42 "
Diameter of dome	26 "
Height of dome	26 "

J. R. S.

A.—The term "Horse Power of a Boiler" has very uncertain meaning. Power, it must be remembered, is developed at the engine from the heat in the steam furnished by the boiler. Some engines will develop a horse power for one hour from the heat in, say, 15 pounds of steam. In others more economical, not more than 12 or 13 pounds would be required, while in others less economical, the steam required will rise to 20, 30 or 40 pounds and over. The actual power which can be gotten out of the boiler depends, therefore, entirely on the engine with which it is coupled up. The boiler which you specify has about 7.28 square feet of grate surface and 284 feet of heating surface. This gives a ratio of about 39 to 1. The boiler should therefore show good economy, or a good return per pound of coal burned. With a good rate of combustion you should be able to burn 20 pounds of coal per square foot of grate per hour. This would give a total combustion per hour of 145.6 pounds of coal. With good economy each pound of this coal should evaporate about 9 pounds of water into steam. This would give 1310.4 pounds of steam per hour. With an engine using 15 pounds per indicated horse power per hour this would give steam for about 87 indicated horse power. If the engine required 20 pounds per indicated horse power per hour it would furnish steam for about 65 indicated horse power only; and if the engine required 30 pounds per indicated horse power per hour, only about 48 indicated horse power could be provided. If, on the other hand, the draft were poorer and less coal were furnished, less power proportionately could be developed, and similarly with more coal, more power; though with the higher rates of combustion the evaporation per pound of coal would decrease somewhat.

From these remarks you will easily see that the horse power of your boiler is a very uncertain thing and cannot be told from the dimensions of the boiler alone.

It may be mentioned that boilers are sometimes rated according to what is often termed "Boiler Horse Power." This is simply horse power based on a certain number of square feet of heating surface per indicated horse power. The figures usually taken are 10 or 12. According to this the boiler horse power of your boiler would be 28.4 or 23.6, according to the number taken. It should be observed that this has no particular or necessary relation to the actual indicated horse power which can be provided with steam from the boiler. In good practice 2½ to 3½ square feet is an ample allowance per indicated horse power.

Q.—Will you please tell me what regulations, if any, control the passage of ships laden with oil through the Suez Canal? H. D. F.

A.—In replying to the above question we make the following extract of the regulations for the navigation of ships laden with petroleum oil in bulk, issued by the Suez Maritime Canal Universal Company:

Any ship laden with petroleum oil in bulk, arriving before any port of access to the Canal, must make herself known by flying at the mizzen one of the following signals:

BY DAY: A red flag above one ball.

BY NIGHT: A white light beneath two red ones.

When the ship goes through the Canal, she must keep the above signals flying during the whole of her transit.

Before the ship enters the Canal, the Captain must sign and hand to the officials of the Company the following declaration:

DECLARATION.

I, the undersigned,.....commanding the ship .....laden with petroleum oil in bulk and belonging to..... owners, do hereby declare, on behalf of the said owners, as follows:

1. This ship is specially classed for the carriage of petroleum oil in bulk in class:*

✠ 100 A1 at Lloyd's in London;

✠ One 3/3 I. I. in the Bureau Veritas;

✠ 100 A4 in the Germanic Lloyd (Berlin);

2. No single tank in the ship has a cubic capacity greater than 500 tons measurement (being tons of 2.83 cubic meters, or 100 cubic feet English) nor can discharge its contents into any adjoining tank through any aperture or want of continuity whatever of its walls;

3. The petroleum oil contained in her tanks is solely refined petroleum of a uniform quality, no sample of which taken at the port of loading shall have given a flashing point below 23 degrees Centigrade (73 degrees of Fahrenheit's thermometer), this temperature having been ascertained conformably with such process of close test as may be recognized and made use of in the petroleum oil trade, as for instance the Abel test or any other close test of a not lesser degree of accuracy;

4. The petroleum oil contained in any of the ship's spaces other than her tanks has a flashing point not under 66 degrees Centigrade (150 degrees of Fahrenheit's thermometer), this temperature having been ascertained as prescribed in paragraph 3.

(Date)

....

Commanding Officer.

* Strike out the names of the offices where the ship is not entered.

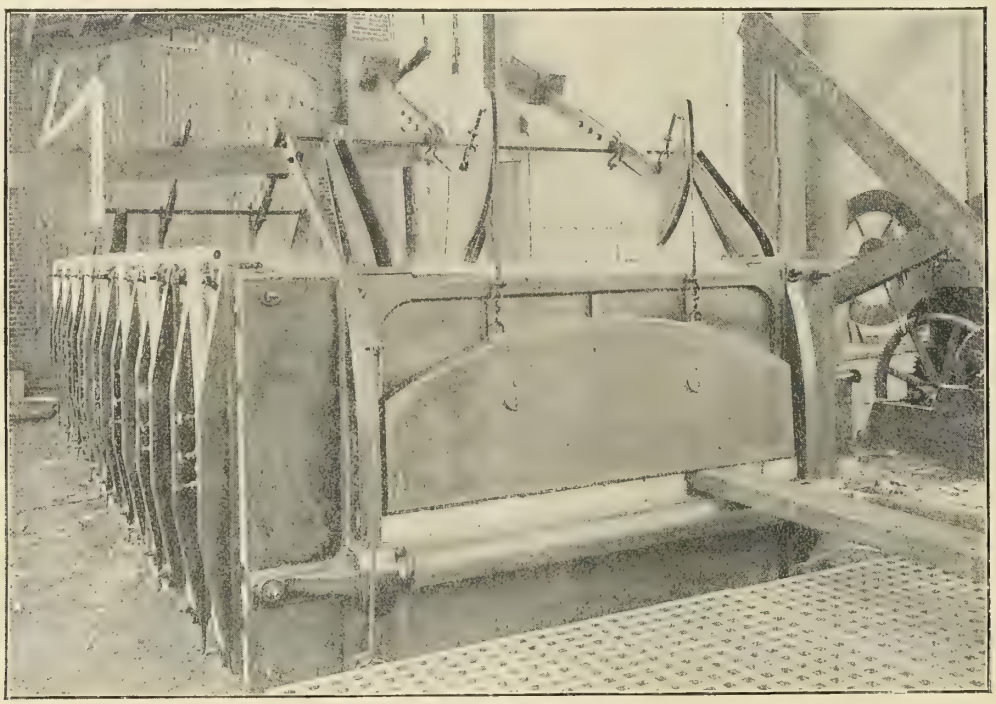
Tank Ship Atlas.—On January 11 the Standard Oil Company's tankship Atlas was launched from the yard of Arthur Sewall and Company, Bath, Me. She is 332 feet long, 45 feet beam and 26 feet deep and is for the oil trade.

ENGINEERING SPECIALTIES.

Plate Furnace with Oil Fuel.

Owing to the general interest in the use of oil fuel among manufacturers in connection with cheap Texas oil, the accompanying illustration of a plate-heating furnace for shipyard work, operated by oil fuel, is of special interest.

Several burners are placed along the side of the furnace shown at the left in the cut, and are supplied by steam from the piping above, and by oil from the piping below led underground from the oil pump. This pump, not shown in the illustration, pumps the oil from the storage tank through a heater mounted in the base of the pump and delivers it at about 170 degrees temperature and 70 pounds pressure to the service lines.



OIL-BURNING PLATE FURNACE.

For regulation there are two valves at each burner; the upper one is a steam valve, and the second one, which is at the burner, is the oil valve. A lower valve is used for turning on or off the supply of oil. The oil is blown into the furnace and atomized by the steam, and the draft, thereby caused, draws in through an opening below the burner, air of sufficient quantity for completing combustion. Combustion takes place in the furnace, where a uniform heat can be maintained. Plates can be quickly and uniformly heated in this furnace without the formation of scale. Another advantage is that these furnaces require no chimney.

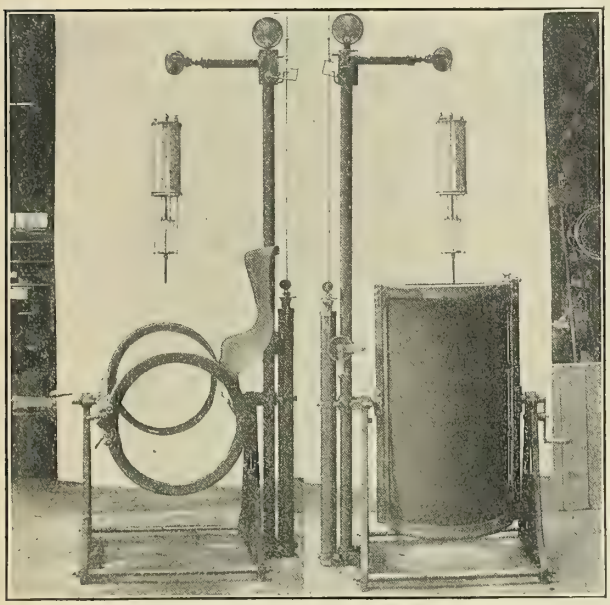
This furnace, and also rivet heaters, angle and forge furnaces of various forms, are built by the Rockwell Engineering Company, 26 Cortlandt street, New York city. The company also has a system for operating marine boilers on shipboard with oil fuel, and has equipped a number of vessels during the past few months with this system.

Electric Blue Print Apparatus.

The accompanying illustration shows a simple but efficient electrical device for making blue prints or photographs indoors at any time of day or night, thus allowing each user to be entirely independent of sunlight.

The machine is self-contained in all of its operations, and does not require an expert to erect it after receipt by purchaser. All machines are tested and adjusted before leaving the factory, ready to operate.

The apparatus consists of a transparent cylinder, rotatably mounted in a portable frame, having means whereby the cylinder may be locked in either a vertical or horizontal position. The lamp is suspended by means of a standard with horizontal arm, this standard being fastened to the extension of the portable frame.



APPARATUS FOR MAKING BLUE PRINTS BY ELECTRIC LIGHT

The lamp (or light) acting as a counter-balance to the piston, is gradually lowered by being attached to the piston rod, which is provided with a valve, for the purpose of regulating the downward speed of the lamp. The range of speed can be adjusted anywhere between five seconds and twenty minutes, depending on the degree of sensitiveness of the paper used.

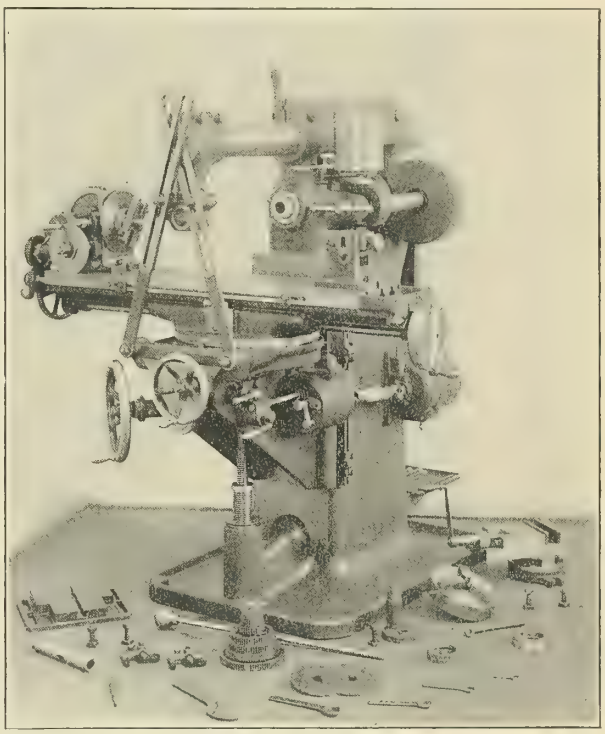
When the lamp (or light) has reached its maximum downward movement, the supply of current is automatically cut off, and the automatic "cut out" is held in this position until the lamp is returned to its normal position, and may be "cut in" at any point where to the lamp may have been lowered by the operator.

The apparatus, which is made in various sizes, may be placed anywhere in a room, and the user will soon determine the proper exposure with reference to the grade of paper employed.

For further information, application may be made to the Elliott Electric Blue Print Company, 723 Liberty avenue, Pittsburg, Pa.

Universal Milling Machine.

The Brown and Sharpe Manufacturing Company, Providence, R. I., has recently placed upon the market a new design of Universal Milling Machine, which is shown by accompanying engravings and embodies new features that are of interest. A feature that attracts attention is the entire absence of the usual feed pulleys and belts, thus eliminating the overhanging brackets and other appurtenances necessary to a belt-driven feed. The variable feeding mechanism, being an entirely new feature, a description will be of interest. It is driven from the main spindle of the machine by a chain and sprocket wheels. The gearing of the mechanism itself being spur gears, and the drive to the feed-clutch gears in the knee being also by spur gears, all with

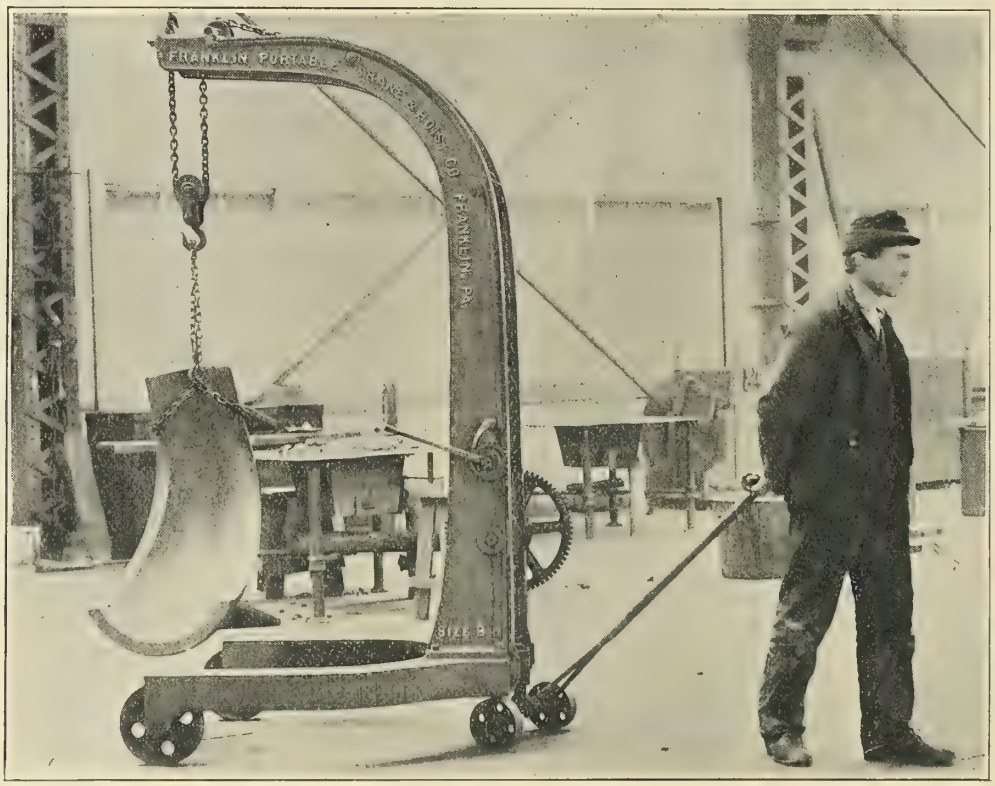


UNIVERSAL MILLING MACHINE

properly arranged bearings, the loss of power by friction is slight, thus making the efficiency unusually high. It is designed to obtain a wide range of feeds, varying in geometrical progression, fully covering all the requirements of modern milling machine practice. The mechanism, as a whole, is self-contained, and care has been taken to insure ease and quickness of manipulation. The drive is from the main spindle of the machine by chain to the sprocket wheel that drives the shaft. This shaft carries the two main driving gears, one gear running directly upon the shaft and the other upon the hub of this gear, these in turn being driven by clutches. The power is transmitted from either of the gears to the intermediate shaft carrying the two sets of gears, which are keyed into position on the shaft and transmit the power to a series of loose gears mounted to run one upon the other. This method of mounting insures long bearing surfaces for each gear.

The power is transmitted from the variable feed

mechanism through the telescopic shaft to the gear case. This case contains the feed reversing mechanism which is operated by a lever, the movement of which serves to start, stop or reverse all feeds. To guard against accidents or breakages, which are inherent in any positively driven mechanism, a safety screw is placed in this telescopic shaft, which is intended to break under any unusual strain and prevent damage to the machine mechanism. The table is heavy in proportion to the capacity of the machine, and provided with T slots sufficiently deep to insure strength. The arc through which the table can be swung is amply long; for example, on the No. 2 machine, this arc is 286°. braces are furnished for tying the arm rigidly. The arbor support, besides carrying a bronze bushing for the arbor bearing, also carries an adjustable center that is always in position. In the design of this machine great care has been taken to secure the greatest efficiency, together with extreme accuracy and simplicity. The parts are so arranged as to be compact and easy of access. As to the rigidity of the machine attention is called to the disposition of the metal, there being no excess where not needed, and when great strength is required the metal will be found to be suitably disposed; for example, the uprights that support the spindle bearings, and the overhanging arm, are solid and rigidly tied.



A PORTABLE CRANE IN USE.

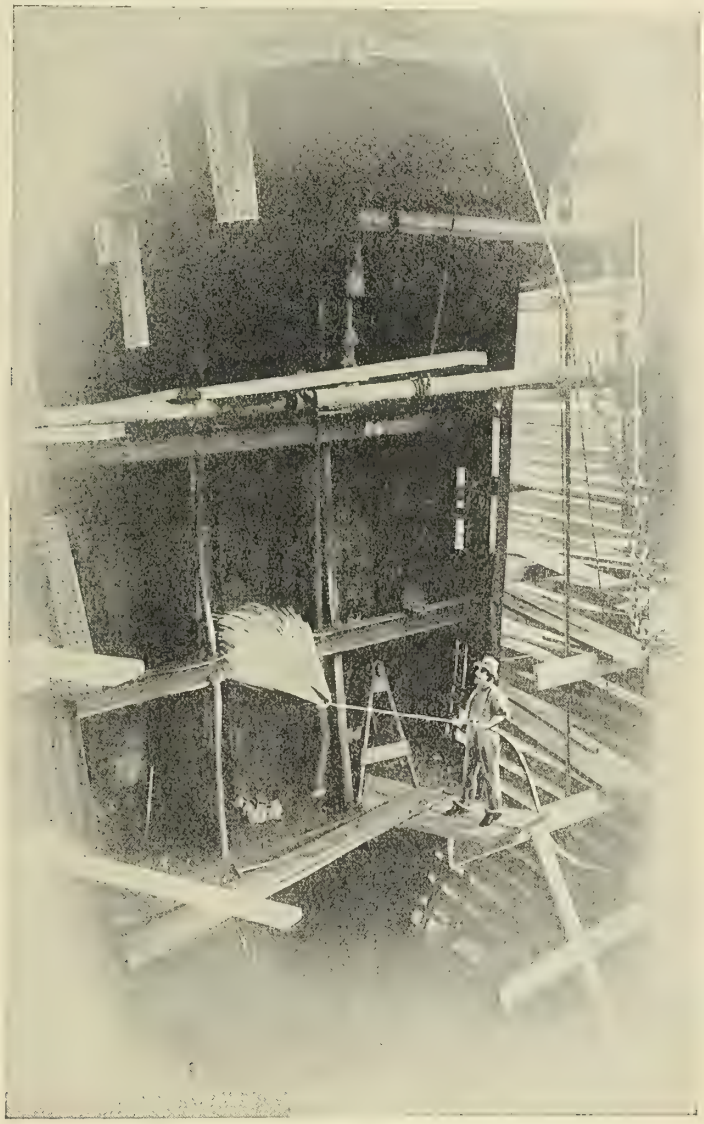
The power feeds can be used with the table set at any angle to 53°, on the No. 2 machine, either side of zero; this is an exceptionally wide range and greatly increases the capacity of the machine for automatically cutting spirals. The telescopic knee screw is another important feature, the advantages of which are readily appreciated, as it does not extend below the base, and the machine can be placed at any point upon the floor, regardless of girders or foundations. The thrust of this screw is taken by ball bearings. The clamping arrangement for the overhanging arm is worthy of attention; it is simple and efficient. One lever, shown at the front of the machine, operates a shaft with rack teeth that engage the nuts on the clamping bolts, thus clamping both ends of the arm with one movement of the lever. The arm being a straight steel bar makes it possible to place any of the regular attachments in position without the necessity of removing the arm. Arm

Portable Crane and Hoist.

A portable hoist built especially for the quick hoisting and transportation of machinery of any shape or weight up to 6,000 pounds, has been placed on the market by the Franklin Portable Crane and Hoist Company, Franklin, Pa. It is a very handy machine and can be used in almost inaccessible places where overhead cranes cannot reach. In every shop there are many spots not covered by cranes or industrial railroad, but the Franklin is serviceable wherever it can be wheeled. One man can operate it, hoist or lower the weight, and transfer it about the shop or yard, and do the work of three with ordinary tackle and hand car. The handle is rigid in the axle, which is a cam, and when raised against the arms the weight of the machine rests on the wheels and axle forming a strong and efficient brake. These cranes have been used satisfactorily for many months by the New York Shipbuilding Company.

A Portable Heater.

A very useful little machine for shipyards, to be used wherever temporary heat is required, is the Ferguson portable heater, illustrated in the accompanying drawing. It consists of a tank mounted on wheels and a long length of hose leading from a compressed air supply pipe to the portable burner. At the half way length of the hose is placed the oil tank and the oil regulating valve. Compressed air enters the regulating valve and there mixes in such proportion with the oil that a perfectly combustible mixture is obtained which is carried through the remaining length of the pipe to the burner. This mixture of oil and air is not affected by friction and the oil will not deposit in the pipe. The mixing valve can be regulated so as to give a greater or less amount of oil, or no oil at all, when it is desired to blow out the pipe. There are many kinds of work in which the Ferguson portable heater can be used, as for heating and expanding a propeller when it is to be removed, expanding socket couplings, etc.; but it is in hull repair work that its greatest field of service is found. Where bent frames and plates are to be straightened this work can be readily done by applying the heat from one of these machines to the bent member and forcing it out in place by strong backs. The cost and time required to heat these plates or angles by the ordinary method is very great in comparison to that when this machine is used. Plates in any part of the ship can be straightened. The discharge pipe from the oil tank can be carried down into the holds and to the most inaccessible places; for the mixture obtained by the valve in the oil tank is such



A PORTABLE HEATER FOR USE IN SHIPYARD REPAIR WORK.

that it can be carried through 200 feet of hose without being affected.

The length, direction, and intensity of the flame are under the complete control of the operator, and a great saving in both time and expense of fuel is secured by the use of this heater. Further inquiries should be addressed to W. M. Simpson, Old Colony Building, Chicago, Ill.

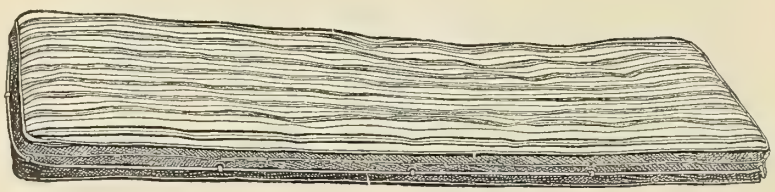
Pneumatic Mattresses and Cushions.

A most important consideration on any vessel, and especially on yachts and launches, is to make life as comfortable and as safe as possible. There is perhaps no device that comes nearer doing this than pneumatic cushions and mattresses. The illustration herewith shows the type of Perfection air mattress manufactured by the Mechanical Fabric Company, Providence, R. I. Mattresses and cushions of the Perfection type add greatly to the safety on board a vessel of any kind, for they are equal to ordinary life preservers, and have many advantages over them, in that they are always at hand and are decidedly useful and ornamental.

On each mattress there is a line to be used for life-saving purposes in case it is necessary to use the mattress in this way. It is claimed that one of these mattresses will keep from sinking as many people as can hold on to the line. Cushions are made in the same way that the mattresses are, and are especially desirable for use in cock-pit seats as well as in chairs and in any place where cushions are needed. Even a small cushion is claimed to have sufficient buoyancy to support as many people as can hold on to it.

The comfort of the mattress can readily be shown by the manner in which it is made. The foundation is strong cotton duck, which is coated with a pure rubber compound, vulcanized, thus making it perfectly air tight and odorless.

The mattress is furthermore properly stayed, so that the shape is always maintained. For covering, anything commonly employed for this purpose may be used, giving them any appearance desired.

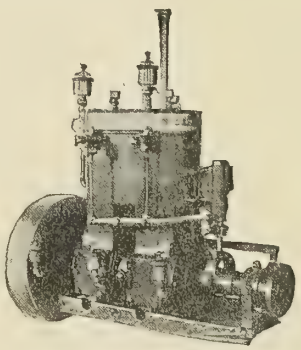


AIR MATTRESS.

Another special advantage of these goods at sea is that they resist moisture, as there is nothing in or about them to absorb dampness or in any way be affected by water. Other important claims are that they are vermin proof, and that they can be used for a great many years with an occasional change of ticking or covering, as there is nothing about them to absorb odors. When inflated they will remain in excellent condition for many months, and, as in the case of yachts, should it be desirable to lay them away for the winter, they can be deflated and stowed away in small lockers. Another important feature in connection with the use of these mattresses is that no springs are needed.

Twin Cylinder Gas Engine.

The Lake Shore Engine Works, Marquette, Mich., are building a twin cylinder engine for small marine work which embodies many excellent features. These twin cylinder engines are cast in one piece, making the two cylinders, crank chambers, bearings, and base plate one solid casting, thus reducing to a minimum the possibility of vibration due to loose joints, etc. The new igniters are driven from an eccentric which operates both the igniters from one rocker arm, and the pump is also driven direct from the same eccentric.



TWO CYLINDER GAS ENGINE FOR LAUNCHES.

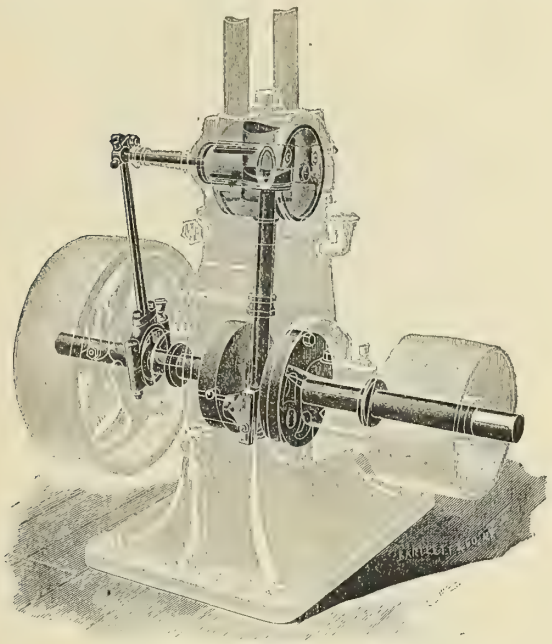
The new type of engine has the fly wheel turned all over, inside and out, and is perfectly balanced, and the balance of the reciprocating parts is also taken care of. Instead of having one cylinder head covering both cylinders, a separate head is fitted for each cylinder, so that if it is necessary to get into one cylinder only one head has to be removed. The firing plugs are removable from the cylinder head without taking it off, and if the insulation gets out of order a new plug entirely can be fitted in less than thirty seconds. All the journals on this engine are phosphor bronze, and every joint is ground metal to metal, with the exception of under the cylinder head, where a metallic gasket is used. The pistons are all ground to a fit with the bore of the cylinder, which is made to a standard gauge with standard reamers, and afterward burnished so as to make as perfect a fit as possible.

It is the aim of the builders to continually improve the engine wherever experience has shown such to be possible, rather than to make an engine which will sell commercially in competition with those of other builders.

ENGINES FOR DIRECT CONNECTED SETS.—III.

High Speed Engines.

The Case engine herewith described has many novel features, and the type is remarkable for simplicity, direct action, compactness, lightness of moving parts, automatic regulation and lubrication. This engine has now been manufactured for ten years, and has a great diversity of application. The accompanying illustrations show, in Fig. 1, a transparent view of the engine illustrating the working parts, and in Fig. 2 the engine direct connected to a generator. As seen in Fig. 1, the piston is direct connected to the crank pin without the intervention of the connecting rod, thus eliminating many parts and wearing surfaces of the common engine. The design is materially lightened, resulting in the attainment of high speed without injurious vibration, and at the same time the increased speed reduces



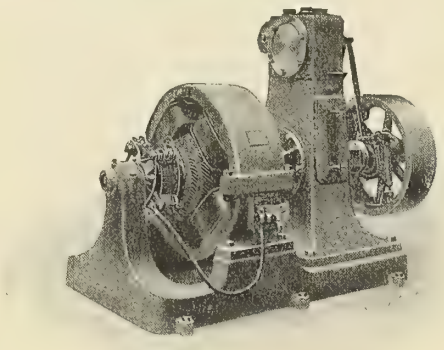
TRANSPARENT VIEW OF CASE ENGINE.

the necessary size of cylinder. By eliminating the connecting rod the height of the engine is also diminished.

One end of the piston is thus connected direct to the crank pin, and the other travels back and forth through the bore of the cylinder, which latter, by reason of its shape, is free to turn in its casing and is rocked by the vibrating piston rod through an arc sufficient to open and close the steam and exhaust ports on its face. A long sleeve screwed into and forming a part of the cylinder, and through which the piston-rod works, imparts the rocking motion to the cylinder.

The upper end of the cylinder is open, so that steam admitted for the downward stroke acts from the head of the piston to the surrounding casing or steam chest, and therefore there is no steam thrust tending to cause friction of the cylinder against the casing. The lower end of the cylinder is closed, but the same thing is accomplished for the upward stroke by the admission of a film of steam to a small balancing chamber hollowed out of the cylinder. By these ingenious methods the friction required to rock the cylinder is reduced to a minimum. This rocking motion is slight, and although the wear is very small, whatever may occur may be taken up by two taper keys which expand the cylinder. The casing surrounding the cylinder is chambered out, forming a steam jacket, so that an equal degree of expansion is carried to all parts of the cylinder.

The action of the fly-wheel governor does not diminish the throw of the valve, but rotates the eccentric on the shaft, and thereby gives the valve the right amount of lead over the crank. The cut-off valve is of the plug type, perfectly balanced and made with a slight taper so that it can always be kept tight. The lower half of the case of the engine forms a reservoir for oil and water, into which the crank pin dips at each revolution. The lubricant is conveyed at every stroke automatically by pockets in the crank disks.



HIGH SPEED ENGINE AND DYNAMO.

The Case engine is manufactured by the New Britain Machine Company, New Britain, Conn., and is built in several types to meet the various demands for light-running high-speed engines.

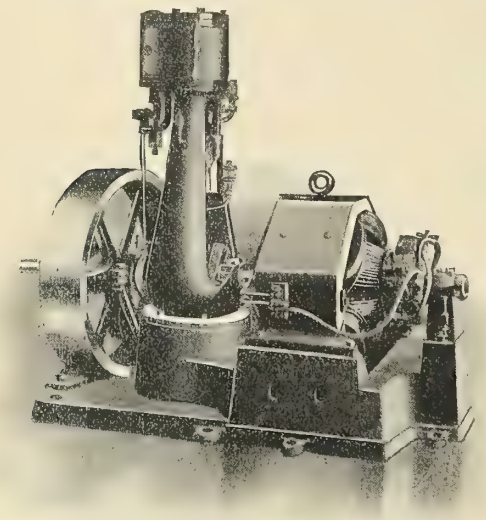
Racine Automatic Engines.

The accompanying illustration shows the Racine Vertical Automatic Engine made by the Racine Hardware Company, Racine, Wis., direct-connected to a generator, and intended for lighting, storage battery or power service. Special attention is called to the neatness of design, compact arrangement and rigid and substantial mounting of the entire unit. These engines are eminently adapted for marine lighting, and for use in all places where economy of space and noiseless operation is desired.

The engine is of the piston valve type with rings in both valve and piston. The valve and governor are perfectly balanced and all moving parts are adjustable. The crank shaft and connecting rod are steel forgings. The crank boxes are babbitt lined, insuring cool running qualities and freedom from cutting. The shaft is supported by a broad out bearing, beyond the governor wheel, which is mounted on the extended base of the engine, thus insuring perfect alignment and additional steadiness of motion. A very important feature in an engine for operating electrical apparatus is the regulation. This governor is of the inertia type, very simple in construction and

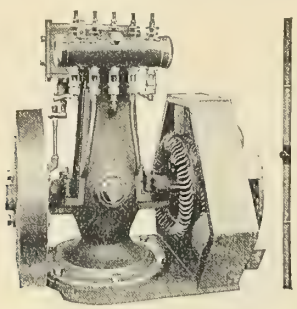
yet so sensitive in operation that a regulation within one per cent from no load to full load is guaranteed. An automatic oiling system is provided, which permits of long continuous runs, as all moving parts can be lubricated while the engine is in operation.

On all direct-connected engines there is furnished a shield on the generator side, which makes the engine practically inclosed and protects the armature from oil or water. In the illustration the shield has



SINGLE CYLINDER RACINE AUTOMATIC ENGINE.

been removed, showing the working parts of the engine. The specialty of this company is the manufacture of high-grade automatic engines of the vertical type, in sizes from 2 to 37 horse power inclusive.

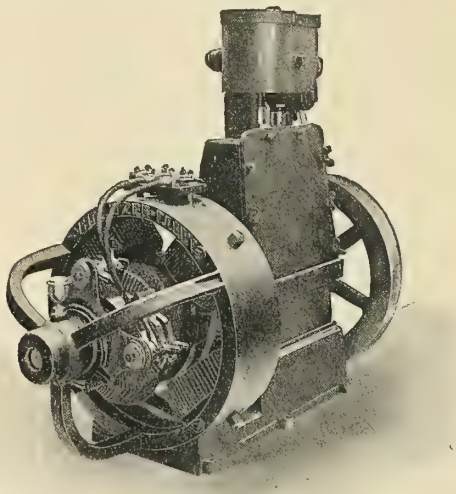


ENGBERG'S SMALL GENERATING SET.

Small Direct Connected Sets.

To meet the increasing demand for small direct-connected generators there has been placed on the market by Engberg's Electrical and Mechanical Works, St. Joseph, Mich., a new type of machine of very compact design. As will be seen by the cut, these generating sets are very small, occupying a space of 18 by 24 inches only. They are, however, being designed and built with as much care as the largest machine, the workmanship and materials being of the very best.

The inclosing of the connecting rod, etc., makes the machine very clean and dust proof. It spatters no oil about. Other very desirable features of this size generator are the automatic cut-off governor and balanced piston valve which insure economy and close regulation, doing away with the old style of cumbersome belted throttling governor. All the bearings are large, and a complete sight-feed oil arrangement connects with all the bearings. This generator was designed for places where space and weight are considered and a small number of lights are necessary besides the search light, such as on steam yachts, tugs, etc. The generator is of the six-pole type wound for 50 volts, thereby doing away with a loss of current in the resistance coils which are necessary on a 110-volt circuit for search light use, and otherwise wound for 110 volts when wanted for that system.



1. 5 K. W. GENERATOR.

Marine Generating Set.

The marine generating set shown in the accompanying cut has been designed to meet a demand for a small and compact set, extreme lightness being especially desired. Aluminum is used very extensively in the construction in portions where great strength is not required. The dynamo is of the multipolar type, the ring and poles being of a high grade of wrought iron, selected on account of its high permeability. It is reduced in weight to as great an extent as can be done without interfering with the performance of the machine. The armature is of the drum-wound type and well laminated. It is mounted upon the engine shaft. The brush holders are of the radial type, such as are used on all Holtzer-Cabot motors. Self-oiling and self-aligning bearings are used. In the cut the dynamo is shown in direct connection with a Herreshoff engine of a recent type, which has been brought out especially for this class of work. It will be observed that all working parts are completely enclosed and run in oil. The engine is of the slide valve pattern with throttling governor. This set weighs about 298 pounds and will supply 30 16 c. p. lamps or 5 watts output per pound weight, at a speed of 850 R. P. M. A line of these sets is being manufactured by The Holtzer-Cabot Electric Company, Boston, Mass.

THE PROFESSOR ON SHIPBOARD.

Story of an Attempt to Combine Theory with Practice.

BY C. A. MC ALLISTER, FIRST ASSISTANT ENGINEER, R.C.S.

CHAPTER IX.

In company with several of the passengers the Professor spent another delightful evening on shore, but as the ship was to sail early the following morning he reluctantly had to forego the pleasures of another comfortable night's sleep at the hotel. As they were rowed out to the ship in a shore boat, the Professor was much impressed with the beauties of the harbor at night. The sky was brilliant with innumerable stars and for the first time in his life he gazed upon the Southern Cross which was pointed out to him. The boat left a golden wake behind her, and each stroke of the oars seemed to make a swirling pool of molten gold, so pronounced was the phosphoresence of the sea water. The faint outline of the steamer could be discerned with the electric lights gleaming through her air ports. From several other vessels in the harbor faint sounds of singing could be heard, and the distant strains of an accordion, the sailor's favorite musical instrument, were wafted over the still waters. Arriving on board he found the Chief Engineer, who informed him that the repairs to the boiler would soon be completed and that they would sail at about five in the morning. When he awoke on the following morning he found that the ship was rolling around in the same old way, and he was brought to a realization that he was once more at sea and subject to the many vicissitudes of the deep. After he had finished his breakfast he strolled out on deck, where his attention was attracted to a group of the passengers standing near the rail engaged in an animated conversation. Listening a few moments to the trend of the remarks, he was surprised to learn that the subject under debate was whether the flying fish, which were at that time very numerous about the ship, actually flew or not. One dogmatic individual took the side that they did not fly at all, and that they simply "soared," as he expressed it. The Professor, after apologizing for breaking into the conversation, asked how it was possible for the small area of the fish's fins to support the weight of the body if the fish simply soared. Continuing, he remarked that the question whether these fish actually fly or not had been discussed at a meeting of a scientific society about twenty years ago. Several of the so-called scientists argued that it was impossible for the creatures to propel themselves through the air owing to the small size of the muscles of the pectoral fins. Their theories were completely routed by a paper read by an engineer officer of the U. S. Navy, wherein by mathematical calculations he demonstrated that it was not only possible but that they actually did fly, as it was shown clearly that "soaring" was an impossibility. This statement led one of the passengers to remark that marine engineers must be very intelligent men to discuss such subjects. To this the Professor replied that the profession of marine engineering was essentially one wherein common sense predominated, and that in his experience he had found that men educated and trained in this branch were enabled to grasp almost any subject and deal with it in an intelligent manner. The diversified problems which present themselves almost daily to sea-going engineers, and the celerity and originality with which they must be met, constitute a mental training which, said he, is calculated to prepare men for almost any walk in life. Continuing, he remarked that some of the most eminent men in the entire engineering profession are those who have served some time at sea. The Professor then cited a number of instances where former marine engineers had attained great prominence in various pursuits on shore. By the time the college man had finished his discourse, that group of passengers, at least, had a much higher opinion of the toilers below.

In the afternoon he was joined by the Chief Engineer, and the conversation drifted to engineering subjects. The Professor asked him how often they took indicator cards from the engine. "Well," replied the Chief, "I don't have them taken very often, as it is too much bother, and besides that I don't see what particular good it does anyhow." "You are mistaken there," replied the college man, "for in my opinion at least, one set should be taken every day. In that way only can you keep track of what your engine is doing. It is not so important to take them for determination of the horse power developed, but you can determine how your valves are set, and whether the valves and pistons are leaking. Of course there are a number of scientific facts to be determined from indicator cards, but for your purposes on board ship it is well to take at least one set every day, for future reference, if for nothing else. He then inquired if the ship was furnished with a set of indicators and the necessary gear for working them. He was informed that there was only one indicator on board, but that the gear was fitted to each of the three cylinders.

"Only one indicator," said the Professor. "Then I don't blame you much for not wanting to take indicator cards, as I have had some experience myself in shifting springs on a hot indicator. I don't see why the owners don't furnish you with a set of three indicators, as the additional first cost is very little when compared with the trouble it gives the engineers in taking a set of cards with a single indicator, not to mention the fact that it is impossible to accurately compute the horse power, unless the cards are all taken at practically the same time."

Continuing, he said: "I haven't seen your indicator gear, but if I was a betting man I would wager even money that the gear is not fitted correctly." "I don't know about that from your standpoint," replied the Chief, "but our gear is fitted in about the same manner as I have seen it fitted to many other steamers." Just to satisfy his curiosity the Professor walked down below in the engine room, and at one glance he discerned that the indicator gear was fitted, in common with a great many other merchant vessels, in a wrong manner. The reducing motion was, of course, taken off the cross-heads through the means of a short link, and an indicator arm pivoted on a stud screwed into the back column, the motion being transmitted to the indicator by means of a string looped over a pin screwed into the arm about 6 inches from the pivot. Returning to the deck he informed his brother that the gear was fitted wrong, just as he had expected to find

it. To a request from the Chief that he would like to have it explained to him wherein the gear was not accurate, his brother replied as follows:

"The most essential thing about an indicator gear is to have the motion of the revolving barrel exactly coincident with the stroke of the piston. That is, every point in the length of the card must correspond exactly to the similar point in the stroke of the piston, or otherwise you will not have an exact representation of the steam and expansion lines on your card. While it is true that for practical purposes a slight discrepancy does not make a great deal of difference, as long as you take indicator cards it is better to have them absolutely correct than to have even the slightest doubt concerning their accuracy. Now," said the Professor, as he pulled out a scribbling pad from his pocket, "here is the manner in which your gear is arranged.

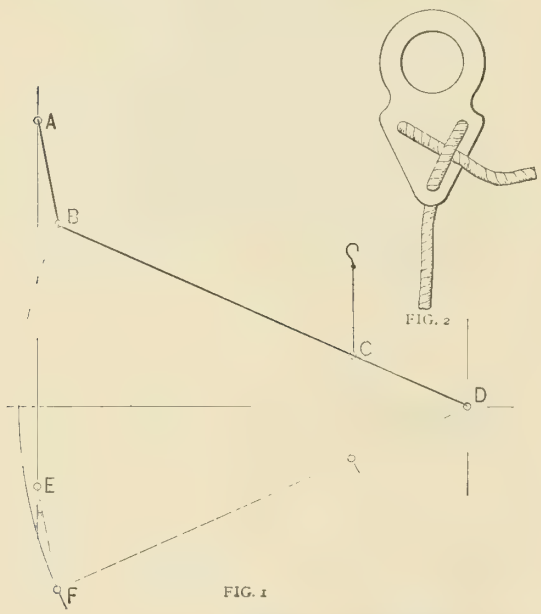


FIG. 1

FIG. 2

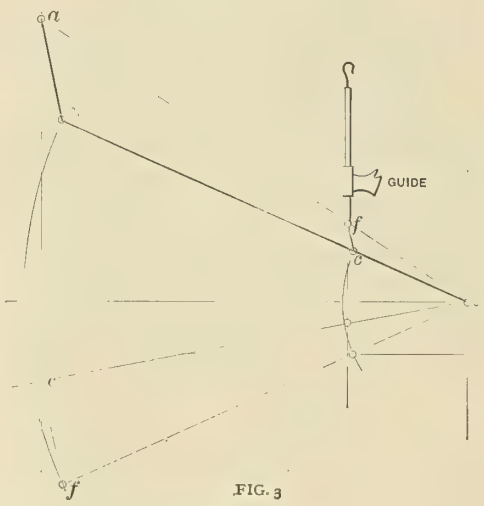


FIG. 3

A CORRECT AND INCORRECT FORM OF INDICATOR REDUCING MOTOR GEARS.

"A is the point on the cross-head of the attachment of the link A B, and B D is the indicator arm. At the point C the pin to which the indicator cord is fastened is screwed into the arm. Now, as you will see, the point A travels up and down on the straight line A E, representing the stroke of the piston. The point B travels on the arc of a circle which has D as its center. As you can easily see, this point B, while traveling on this arc, does not cover the same distance in a vertical direction as does the point A, which is going up and down in a straight line. Now the same can be said of the point C, which also travels on the arc of a circle, and hence does not impart a motion to the indicator barrel accurately coincident with the stroke of the piston.

"Here is how this difficulty can be overcome, and is the way that all indicator motions should be arranged:

"By fitting a small link to the indicator rod at the point C, and connecting the other end of it to a vertical rod guided as I have shown it, you will find that a correct motion is given to the indicator barrel. The length of the small link *c f* should be such that the point *f* is at the intersection of the line *a d* with the vertical line through the center of the rod, and hence is proportional to it. The links *a b* and *f c* will then be parallel, and as a result the point *f* will always have a precisely similar motion to the point *a*; that is, the barrel on the indicator will be given a motion in a constant proportion to that of the piston, which accomplishes the desired object."

"I can see the point of your argument," said the Chief Engineer, "but I really don't see that it makes much difference practically, only as you say, if we are going to have indicator gearing fitted, it might just as well be correct."

"Another good feature about this kind of a rig," continued the Professor, "is to have these vertical rods run up to about two feet below the indicators, and leave the top ends forged into the shape of a hook. The strings can then be attached to these hooks by the man using the indicator, without the bother of crawling down below and performing sleight-of-hand tricks every time he tries to loop the string over the pin on the indicator arm."

"By the way," said the Professor, "if you don't object I will go down below this evening after it gets cool and take a few cards off the engine."

His brother assured him that he would be very much pleased to have him do so, and that he would go down and help him.

After dinner was over that evening the Professor donned his overalls, which he had taken pains to have washed white while he was in port, and bravely marched into the engine room, not forgetful of his past experiences there. He was agreeably surprised to find that after sundown it was not quite so warm as it had been, and that the breeze coming down the ventilators kept the temperature of the engine room down to a moderate point. The Chief sung out for Barney to get

the indicator out of the store room. After considerable delay he managed to find it, all covered over with dust in an out of the way corner. Upon opening the box the Professor found, much to his disgust, that when last used the spring had not been removed and that the interior of the instrument had not been properly dried out and oiled. As a result the spring was quite badly rusted, sufficiently so to make it unreliable in recording pressures. The Chief inquired if there was not a rule governing the strength of springs to be used in indicators. To this the college man said that he knew of no rule applicable to all cases, but that in his opinion, for a triple expansion engine using a boiler pressure of 160 pounds per square inch, it would be a good proportion to use springs of 80, 40 and 20 pounds' strength respectively in each of the three cylinders. He further said that it was a good rule to select springs which would not give cards over two inches in maximum height, and that it was also a good idea to so arrange the reducing motion as to give cards of a uniform length of four inches. He also said that a 20 pound spring in the low pressure indicator would not give a card much more than one inch in height, but it was better to use a spring of that tension in order to prevent the pronounced vibration which would necessarily result from the use of a lighter spring.

Selecting the proper spring for a high pressure card, he fitted it in place and oiled the steam cylinder with some cylinder oil, remarking as he did so that it would be much better to use a lighter grade of oil, such as is furnished by the manufacturers with the instrument. A new piece of string was cut off the hank in the box and Barney was directed to loop it over the pin on the indicator arm, which he succeeded in doing after a number of efforts. The Chief gave the indicator pipes a good blowing out and then secured the instrument in place. The next thing was to adjust the string so as to give the barrel an even stroke at the ends. After making a number of new slip-knots this was finally accomplished. The Professor explained to his brother that it was a good scheme to have a small flat piece of brass with three holes bored in it so that the length of string could be more readily adjusted. To illustrate his remarks he made the sketch shown in Fig. 2.

The Chief promised to have one made for him, and remarked that he had seen such a device before, and that it was all right. The Professor next sharpened the pencil at the end of the indicator lever, saying as he did so that he preferred to use chemically prepared indicator cards upon which a black mark could be made with a sharp pointed brass screw instead of a lead pencil. Everything being ready the Professor drew the atmospheric line, calling his brother's attention to the fact that during this operation the lever on the indicator cock should always be so placed as to connect the interior of the steam cylinder with the atmosphere, as otherwise the leakage through the cock might affect the height of the line. After very dexterously taking several cards the Professor said that as it was getting rather late in the evening he would "turn in," but promised that on the next day he would have something further to say about the indicator cards themselves.

TECHNICAL PUBLICATIONS.

Marine Boilers, by L. Bertin, Director of French Naval Construction. Size 8vo., pp. 566 with 300 figures. Price 25 francs. Paris, E. Bernard & Co.

This book is the second edition of the well-known work published by M. Bertin in 1896 and which was made familiar to English and American engineers through the translation by Robertson. These works have become so well known through the first edition, both in French and English, that no extended notice of the book as a whole is called for at the present time, and it will be sufficient to refer briefly to the changes and additions.

In the amount of matter as compared with the first edition we find a notable increase, the total addition amounting to 130 pages, with an increase in the number of figures from 233 to 300. The added matter is distributed throughout the book and is intended to bring the work more completely down to date, and to amplify various topics which have increased in importance since the publication of the first edition. Thus a considerable addition is made to Chapter V, dealing with the use of liquid fuel. The later methods and appliances are discussed and the subject is brought down to the present time. Large additions are also found in the chapters dealing with the various forms of water tube boilers, as we should expect from the activity in that part of the marine field, and the prominence which this type of boiler is taking on, especially in naval practice. Some further additions are also found in the chapters dealing with attachments and accessories.

Taken as a whole this new edition maintains the high standard of excellence set by the first issue, and furnishes on the subject of marine boilers, and especially as viewed from the standpoint of French and Continental practice, the most comprehensive and extended presentation to be found.

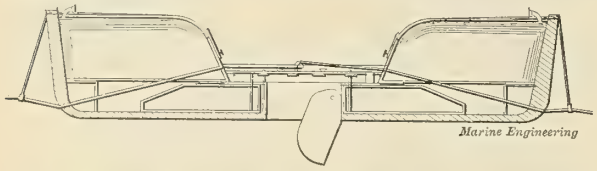
Great Changes in Power.—With its April issue *Power* appears in a new form, having been reduced to 9 by 12 inches in size. Typographically, the change is as great as from a brass stencil and blacking brush to a fine modern printing press; the result is one of the handsomest publications in the engineering field. Editorially, it gives evidence of as great a change, for broad-minded management is now very evident. *Power* is published by the Hill Publishing Company, World Building, New York. The price has been increased to $2 a year; this, however, is only 100 per cent. change, while the other changes are several hundred.

Objections to Searchlights.—Many complaints have been filed in the Treasury Department, Washington, against the temporary blinding of steamer pilots by searchlights on other vessels. These complaints are coming mostly from the Great Lakes, and are so numerous that a rule has been embodied in the steamboat regulations recently issued by the Department, as follows: "That masters, mates and pilots of all vessels be required to exercise due caution in the use of their searchlights so as not to throw the rays of light into pilothouses of passing steamers. A wilful violation of the above requirement will subject the offender to a suspension or revocation of license."

SELECTED MARINE PATENTS.

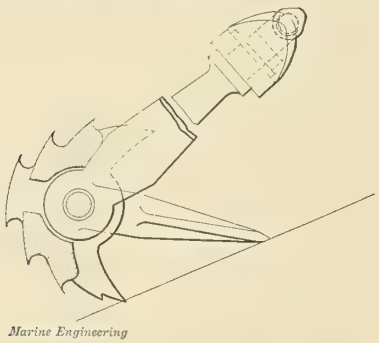
695,634. LIFE-BOAT. CHARLES DICKENSON, WASHINGTON, D. C.

Claim.—The combination with a life-boat provided with a sunken deck and hoods extending above said sunken deck, one hood at each end of said boat; each of said hoods provided with an air-tube extending above and opening outside of said hood; open shelves secured to the body of the vessel below the deck thereof in near proximity to the lower ends of said hoods; a self-acting pivot-valve; a chain provided with a ball, whereby the self-acting valves will be operative when said boat is on its bilge or when entirely inverted.



2. A life-boat comprising a hull; a sunken deck; a centerboard-well forming a self-bailing compartment in communication with said sunken deck; longitudinal bulkheads forming continuations of said centerboard-well, and forming also, part of the longitudinal bulkheads beneath said sunken deck; and fresh-water tanks located at the opposite ends of said centerboard-well; substantially as and for the purpose set forth. Four claims.

695,711. ANCHOR. JOHN EYNON, GATESHEAD, ENGLAND, assignor of two-thirds to William Summerbell Richardson, Gateshead, Durham County, England, and Edward John Williams Powell, Newcastle-upon-Tyne, England.



Claim.—1. In a tripping-anchor, a head capable of partial rotary movement relatively to the shank, and a member disposed between the flukes and provided with projections upon opposite sides of the shank forming successive trips, substantially as described.

2. In a tripping-anchor, a head capable of partial rotary movement relatively to the shank, a crown having auxiliary trips, and a member disposed between the flukes and provided with a series of projections forming successive trips, substantially as described. Four claims.

695,717. PROPELLER GEAR. GEORGE W. GARDINER, PHILADELPHIA, PA.

Claim.—1. The combination with a marine vessel having a trunk therein, of a frame mounted in the trunk and movable downward to a point below the vessel, a propeller-gear carried in the frame, and a centerboard working in the trunk independently of the said frame. Two claims.

695,758. BOAT. WILLIAM C. McELHENY, PITTSBURG, PA.

Claim.—1. The combination with an open flat-bottomed boat having external vertical sides and inclined ends, of supplemental internal side walls inclining toward the bottom and thence extending vertically to said bottom, said walls forming one continuous passage or receptacle from one end of the boat to the other. Two claims.

695,917. BOAT. AMBIEHL DOMINICK AND LOUIS KREBS, NEW YORK, N. Y.

Claim.—1. In a boat, a pair of crank-shafts combined with bent arms mounted thereon and having their ends placed at a greater distance from the boat than their center, and with blades connected to said arms and bent to form laterally-opening scoops. Two claims.

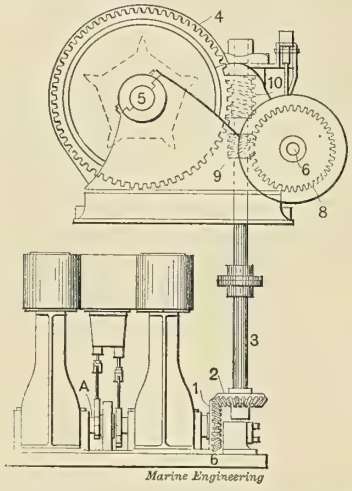
696,097. AUTOMATICALLY-PROPELLED MULTIPLE-HULL VESSEL. JAMES GRAHAM, NEW YORK, N. Y.

Claim.—1. A series of floats or hulls hinged together transversely and longitudinally and having power-generating mechanism connected therewith for propelling said floating structure.

2. A series of floats or hulls hinged together fore and aft and adapted to oscillate as they move through the water of flotation and having power-generating mechanism attached to the connecting hulls above and below the hinged points.

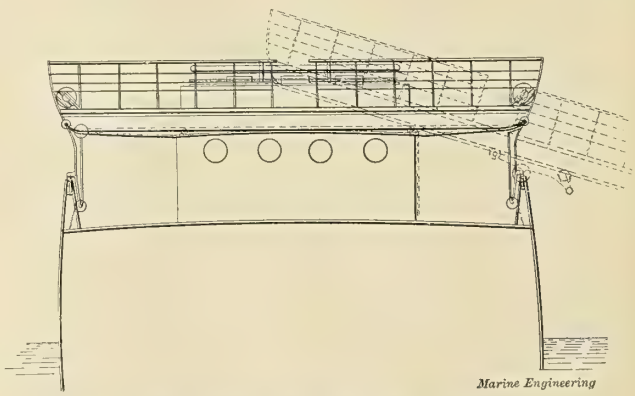
3. A series of floats or hulls hinged together side by side and adapted to rock in the water of flotation, said hinged hulls having mechanism connected therewith for generating power. Sixteen claims.

696,394. COMBINED WINDLASS AND WARPING-WINCH. JACOB R. ANDREWS, BATH, MAINE.



Claim.—In combination with the windlass and the worm-gear upon its shaft, a shaft as 3 having a worm 10 in mesh with the gear upon the windlass-shaft, a second worm 9 on the same shaft, a shaft 6 carrying winch-heads and provided with a worm-gear 8 in mesh with the second worm on the main driving shaft 3, all substantially as described. One claim.

696,463. LIFE-RAFT. DANIEL G. MARTENS, LONDON, ENGLAND.



Claim.—1. In a ship or vessel fitted with detachable floatable sections or rafts resting on the deck house or houses, means for launching the rafts, comprising raising-levers, pivoted to the deck house or houses and adapted when turned to raise and support the raft above the roof of the deck house or houses, and swinging stanchions pivoted to and turning on the taffrail or other fixed part of the vessel and carrying rollers on their extremities, said stanchions being normally held upright by powerful springs and maintained in that position by a cord or the like detachable means, substantially as described. One claim.

696,621. LIFE-BOAT, ETC. CARL E. BAARSEN, BERGEN, NORWAY.

Claim.—In combination, the curved keel, air chambers beneath the thwarts as well as in the upper part of the stem and stern, and a ballast-tank midship provided with stop-cock rod and handle, said ballast-tank being in the bottom of the boat and controlled by said stop-cock, substantially as described. One claim.

696,703. HAND-POWER PROPELLER. ISAAC A. WILSON, DETROIT, MICH.

Ship for Coronation Ceremonies.—The U. S. battleship *Illinois* has been chosen to represent the government at the coronation of King Edward VII. Admiral Crowninshield will be in command.

Marine Engineering

Vol. 7. NEW YORK, JUNE, 1902. No. 6.

CHESAPEAKE AND OHIO RAILROAD PASSENGER STEAMER VIRGINIA.

The *Virginia* is a twin screw passenger boat of about seven hundred tons displacement, and was built by the William R. Trigg Company, of Richmond, Virginia, on their own plans and specifications. The contract was signed in August, 1901, and she was turned over to the Chesapeake and Ohio Railroad Company in January, 1902.

She is to rate A1 for 20 years, according to the U. S. Standard Registry of Shipping. The speed guaranteed was 18 knots, to be maintained over a measured course.

Stern post cast steel, tensile strength at least 52,000 pounds per square inch.

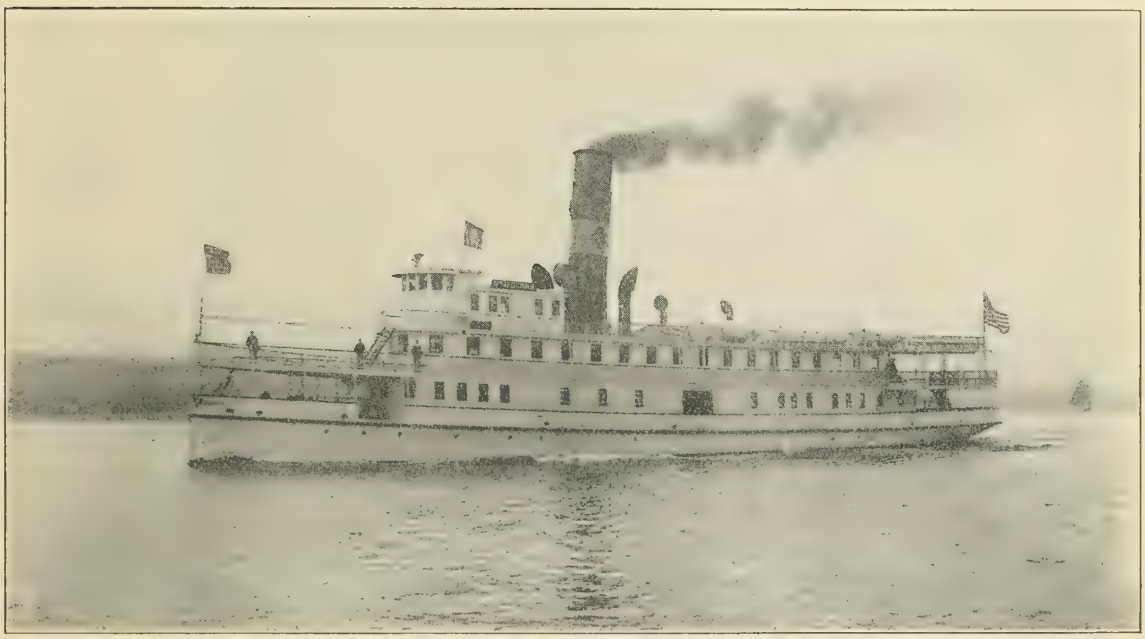
Sheer strake 40 inches wide, 20-pound plate for one-half length amidships, reduced to 15 pounds at ends.

Bilge, side and bottom plating, 15 pounds for one-half length, reduced to 10 pounds at ends.

Doubling plates worked for about ten feet abaft stem, along load water line. Bulwarks 7 1-2 pounds.

Main deck 3-inch yellow pine, other decks 1-inch yellow pine, tongued and grooved, exposed parts covered with No. 5 cotton duck.

Side lights 9 inches in clear.



STEAMER VIRGINIA BUILT BY THE WM. R. TRIGG CO.

The general dimensions are given in the table at the end of this article.

HULL.

The hull is constructed of open hearth mild steel, of domestic manufacture, of not less than 55,000 pounds or more than 65,000 pounds tensile strength, 26 per cent. elongation in 8 inches, elastic limit one-half ultimate strength, cold bending test 180 degrees without fracture. Rivets to be not less than 56,000 pounds tensile strength.

Following are some of the leading scantlings:

The keel, flat plate type, 24 inches wide.

Center vertical keel, 12 1-2 pound plate, 22 1-2 inches deep.

This boat, made after the design of Mr. J. A. Nelson, superintendent, is an example of a hull without hollow lines. The forward section, just abaft the bow, is club foot; that is very full at the bottom. The dead wood is done away with, avoiding hollow water lines. Consequently the boat drives very well in shallow water, the tendency being always for the boat to seek the surface of the water; the faster she goes the more the tendency to decrease the displacement. The idea has been worked out very well indeed, and the performances of the boat during the trial trip fulfilled the highest expectations of the assembled experts.

The vessel was delivered to the owners complete in every particular, paint work bright and clean, com-

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passes adjusted to boat, all boats and outfit in place, and all in first-class condition.

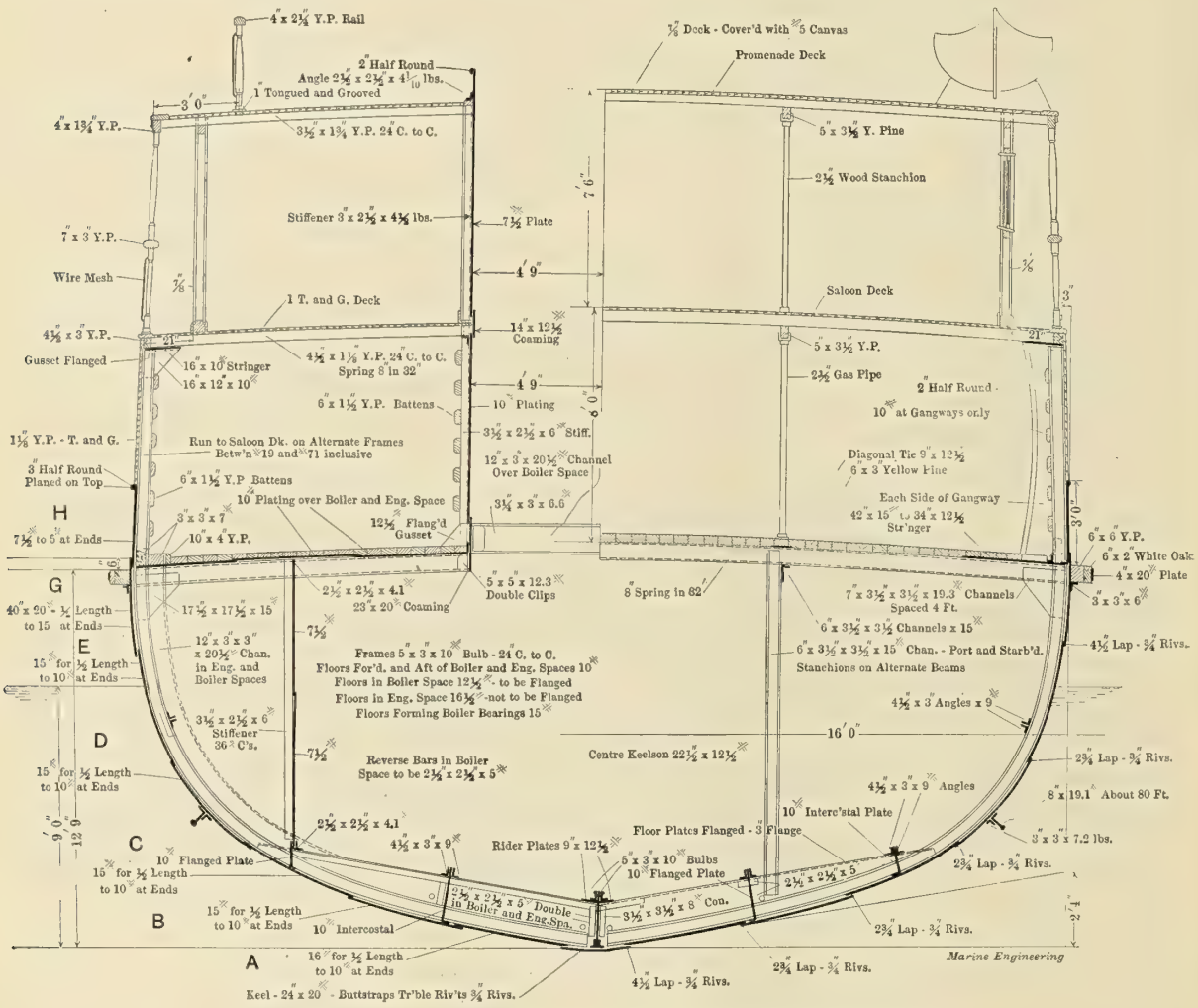
PROPELLING MACHINERY.

There are two vertical, inverted, direct-acting, triple expansion, three-cylinder engines, placed in a common compartment, the two engines side by side, turning inboard. In the cylinder arrangement the H. P. cylinder of each engine is forward and the L. P. aft. The cylinders are supported by forged steel columns at the front and cast iron columns at the back, cast with the condenser, which thus forms a part of the engine framing. Live steam may be admitted to both receivers.

The connecting rods, eccentric and valve rods, and crossheads are of forged steel with high tensile strength.

The go-ahead face of the crossheads is fitted with white metal; the slippers are made of manganese bronze. The ahead guide is of cast iron, bolted to the back columns of the engine, which in turn are cast with the condenser. Cast iron lips are bolted on each side of the ahead guide to take the thrust when backing.

The eccentrics are of combination wrought and cast iron, each in two parts, keyed to the shaft. The eccentric straps are of phosphor bronze, lined with white metal.


4" x 2¼" Y.P. Rail
2" Half Round
Angle 2½" x 2½" x 4 10/10 lbs.
1" Tongued and Grooved
3' 0"
4" x 13/4" Y.P.
3½" x 1¾" Y.P. 24" C. to C.
Stiffener 3" x 2½" x 4½ lbs.
7½" Plate
7" x 3" Y.P.
Wire Mesh
7/8"
1 T. and G. Deck
4' 9"
4½" x 3" Y.P.
Gusset Flanged
16" x 10" Stringer
16" x 12" x 10"
4½" x 1⅛" Y.P. 24" C. to C.
Spring 8" in 32"
14" x 12½" Coaming
6" x 1½" Y.P. Battens
10" Plating
1⅛" Y.P. - T. and G.
Run to Saloon Dk. on Alternate Frames
Betw'n 19 and 71 inclusive
3" Half Round
Planed on Top
6" x 1½" Y.P. Battens
10" Plating over Boiler and Eng. Space
3½" x 2½" x 6" Stiff.
12" x 3" x 20½" Channel
Over Boiler Space
3¼" x 3" x 6.6
H
3" x 3" x 7
7½" to 5" at Ends
10" x 4" Y.P.
12½" Flang'd
Gusset
2½" x 2½" x 4.1
23" x 20" Coaming
5" x 5" x 12.3
Double Clips
8" Spring in 62"
G
40" x 20" - ½ Length
to 15" at Ends
17½" x 17½" x 15"
7½"
E
15" for ½ Length
to 10" at Ends
12" x 3" x 3"
x 20½" Chan.
in Eng. and
Boiler Spaces
Frames 5" x 3" x 10" Bulb - 24" C. to C.
Floors For'd. and Aft of Boiler and Eng. Spaces 10"
Floors in Boiler Space 12½" - to be Flanged
Floors in Eng. Space 16½" - not to be Flanged
Floors Forming Boiler Bearings 15"
3½" x 2½" x 6"
Stiffener
36" C's.
D
15" for ½ Length
to 10" at Ends
7½"
Reverse Bars in Boiler
Space to be 2½" x 2½" x 5"
Centre Keelson 22½" x 12½"
16' 0"
2½" x 2½" x 4.1
4½" x 3" x 9"
Rider Plates 9" x 12½"
Floor Plates Flanged - 3" Flange
10" Flanged Plate
15" for ½ Length
to 10" at Ends
C
5" x 3" x 10" Bulbs
10" Flanged Plate
2½" x 2½" x 5"
3½" x 3½" x 8" Con.
2½" x 2½" x 5" Double
in Boiler and Eng. Spa.
15" for ½ Length
to 10" at Ends
B
10" Intercostal
16" for ½ Length
to 10" at Ends
A
Keel - 24" x 20" - Buttstraps Tr'ble Riv'ts ¾" Rivs.
4½" Lap - ¾" Rivs.
2¾" Lap - ¾" Rivs.
2¾" Lap - ¾" Rivs.
2¾" Lap - ¾" Rivs.
4½" x 3" 9 Angles
10" Intercostal Plate
8" x 19.1 About 80 Ft.
2" x 3" x 7.2 lbs.
4½" x 3" x 9 Angles
4½" x 3" x 9 Angles
16' 0"
12' 9"
9' 0"
7' 6"
6' 0"
2' 7"
⅛"
3"
21"
Marine Engineering
⅛" Deck - Cover'd with 5 Canvas
Promenade Deck
5" x 3½" Y. Pine
2½" Wood Stanchion
Saloon Deck
5" x 3½" Y.P.
2½" Gas Pipe
2" Half Round -
10" at Gangways only
Diagonal Tie 9" x 12½
6" x 3" Yellow Pine
Each Side of Gangway
42" x 15" to 34" x 12½
Str'nger
6" x 6" Y.P.
6" x 2" White Oak
4" x 20" Plate
3" x 3" x 6"
7" x 3½" x 3½" x 19.3" Channels
Spaced 4 Ft.
6" x 3½" x 3½" Channels x 15"
6" x 3½" x 3½" x 15" Chan. - Port and Starb'd.
Stanchions on Alternate Beams
4½" Lap - ¾" Rivs.
2¾" Lap - ¾" Rivs.

MIDSHIP SECTION OF THE PASSENGER STEAMER VIRGINIA FOR THE CAPE CHARLES ROUTE.

The main valve for the H. P. cylinder is of the single ported, piston valve type, while those for the I. P. and L. P. are double ported slides. The valve gear is of the Stephenson link type, with double bar links. There are no independent cut-off valves, but provision is made to vary the cut-off in each cylinder from 5/10 to 7/10 of the stroke in the usual manner by means of a block moved by a hand screw geared in a slot in the end of the arm on the reversing shaft.

The main pistons are of cast steel, dished, and are fitted with two packing rings. The piston rods, con-

Each engine bed plate is made of cast iron, in one piece, and bolted to the condenser by the flanges at the ends of the six girders of the bed plate.

The reversing gear consists of a steam cylinder 9 inches in diameter and with an 11-inch stroke, with piston acting directly on an arm fixed on the reversing shaft. The valve of this engine is worked by a system of differential levers, the primary motion being derived from the hand lever at the working platform and the secondary motion from a point on the reversing arm. The turning gear consists of a worm wheel on the

main shaft, worked by a worm with a hand ratchet.

Each engine is fitted with a double poppet balance stop valve, 6 inches in diameter.

Following are some of the principal engine dimensions:

The cylinders are 17, 27 and 43 inches in diameter by 24 inches stroke. The valve stems are 2 1-4 inches diameter and the piston rods 3 1-2 inches diameter. The length from center of crosshead to under side of piston is 3 feet 9 3-8 inches. The connecting rods are 4 feet 8 inches center to center, 3 3-4 inches diameter at upper end and 4 3-4 inches at lower end. The crank pin bolts are 2 inches diameter. The crossheads are 13 1-2 inches long and have a go-ahead bearing surface 10 1-2 inches broad and a backing surface 8 3-4 inches wide.

The crank, thrust, stern tube and propeller shafting is solid, of high tensile forged steel. The crank shaft of each engine is in two pieces, the coupling being between the H. P. and I. P. cyclinders. The cranks are set at angles of 120 degrees with each other, and the sequence of cranks is H. P., I. P. and L. P.

The propeller shafts are covered with a composition casing, and there are two bearings in each stern tube, which is of cast iron.

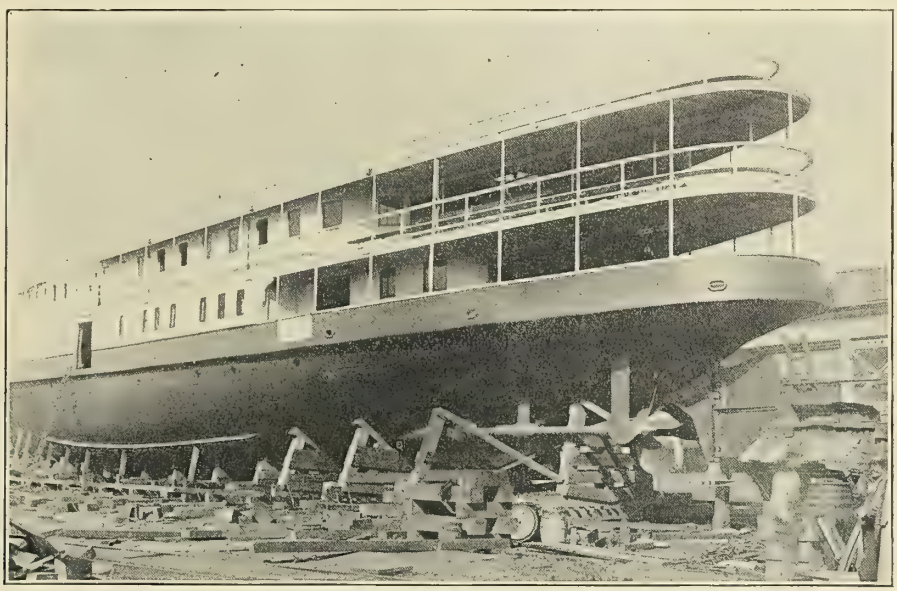
Each thrust bearing is of the horse-shoe type, secured firmly to the frames of the hull. The bearing faces are of white metal, channeled for the distribution of oil.

Following are the principal dimensions of this part of the machinery:

Crank shaft, diameter 8 inches.
Coupling disk, diameter 16 inches.
Coupling disk, thickness 2 1-2 inches.
Tapered bolts, mean diameter 2 inches.
Journals, diameter 8 inches.
Journals, length 8 1-4 inches.
Crank pins, diameter 8 inches.
Crank pins, length 9 inches.
Crank webs, width 9 inches.
Crank webs, thickness 4 3-4 inches.
Thrust shaft, diameter 8 inches.
Collars, number of, 8.
Collars, diameter 14 inches.
Collars, thickness 1 5-8 inches.
Collars, space between 3 1-4 inches.
Stern tube shaft, diameter 8 1-2 inches.
Propeller shaft, diameter 8 1-2 inches.

There are two main condensers, one for each engine. They are of cast iron and form a part of the framing and bed plate of the engine. Each condenser is cast in one piece of 1-inch metal. The water passes twice through it, once forward and once back. This water is furnished by an independent centrifugal pump, one to each condenser. Following are the principal dimensions:

Thickness of shell, 1 1-8 inches.



THE VIRGINIA READY FOR SIDE LAUNCHING FROM THE YARD OF WM. R. TRIGG CO.

Width, inside, 21 inches.
Height, over all, 4 ft. 11 inches.
Tubes, diameter 5-8 inch outside.
Length between tube sheets, 10 ft. 4 1-2 inches.
Thickness of tubes, 18 B. W. G.
Number of tubes to each condenser, 809.
Total cooling surface both condensers, 2,750 sq. ft.
Ratio of cooling surface to heating surface in boilers, 1 : 2.43.

There is one air pump for the two condensers with one 12-inch steam cylinder and two 20-inch buckets, with a stroke of 12 inches. The pump is arranged to draw from the condensers of both engines and discharge into one common hotwell. Steam is taken from the auxiliary steam pipe with a 1 1-2-inch pipe and the exhaust goes into either condenser, or atmosphere.

For each main condenser there is a centrifugal double-inlet circulating pump, which is arranged to draw from the sea and bilge. It is driven by an in-

dependent vertical, single cylinder engine. Following are the principal dimensions:

Steam cylinder, diameter 6 inches by 6-inch stroke.
Diameter, pump runner, 30 inches.
Width at periphery, 4 inches.
Diameter of inlet nozzle, 8 inches.
Diameter of outlet nozzle, 8 inches.

The screw propellers are two in number, of cast steel, of the modified Griffiths type, each with three blades. They are true screws, bent backward 6 inches at the periphery. The starboard, left hand. The port propeller, right hand. Each propeller is secured to its shaft by a single key and a composition nut, screwed on and locked in place. Following are the principal dimensions and data:

Number of blades, 3.
Diameter, 8 ft. 0 inches.
Length of hub, 18 3-4 inches.
Pitch, 11 ft. 9 inches.
Greatest width of blade, 32 3-4 inches.
Helicoidal area, 21 square feet.
Disk area, 50.26 square feet.
Pitch ÷ diameter, 1.47.
Helicoidal area ÷ disk area, .417.

BOILERS.

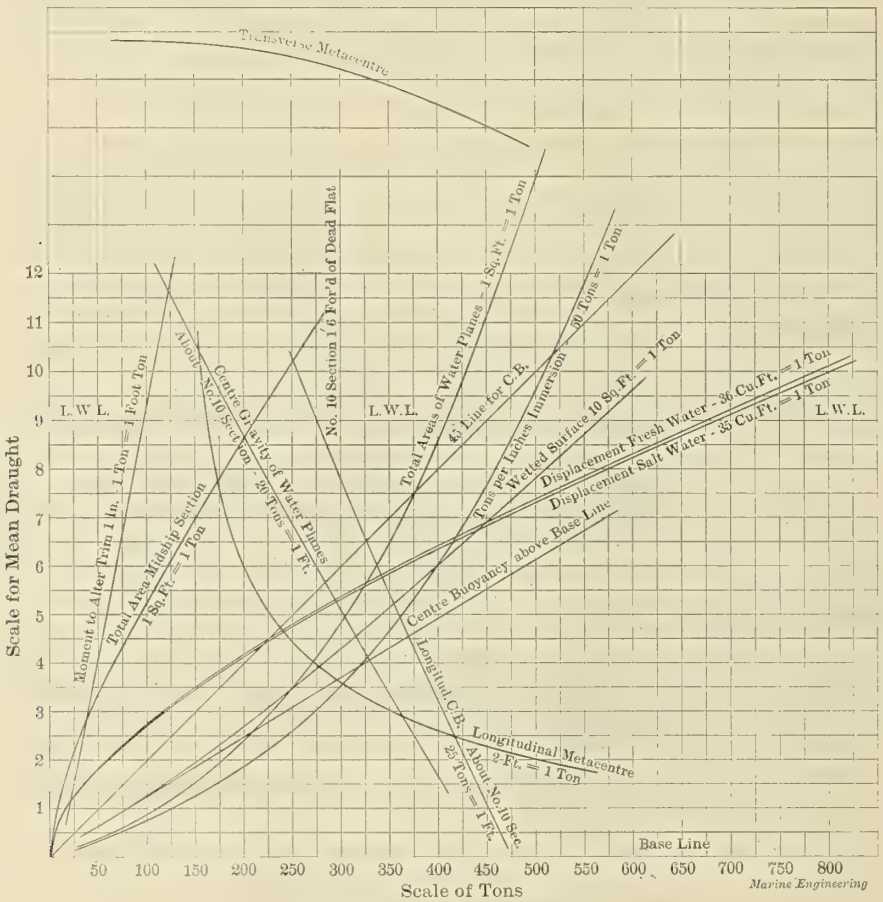
There are two Thornycroft boilers, of the improved Daring type.

In this type of boiler there is one steam drum, situated at the apex of a triangle, and three water drums, equidistant along the base line, one being at each corner and one in the middle. The steam drum is connected to the water drum by a number of curved tubes of small diameter, for the generation of steam. The steam drum is also connected to the center water drum by down take pipes for the water circulation. The back and front of the furnace are built up to the arch of the tubes with fire brick, and on each side to the joint of the tubes with the water drums. Each boiler is bolted to angle irons which are riveted to the saddles.

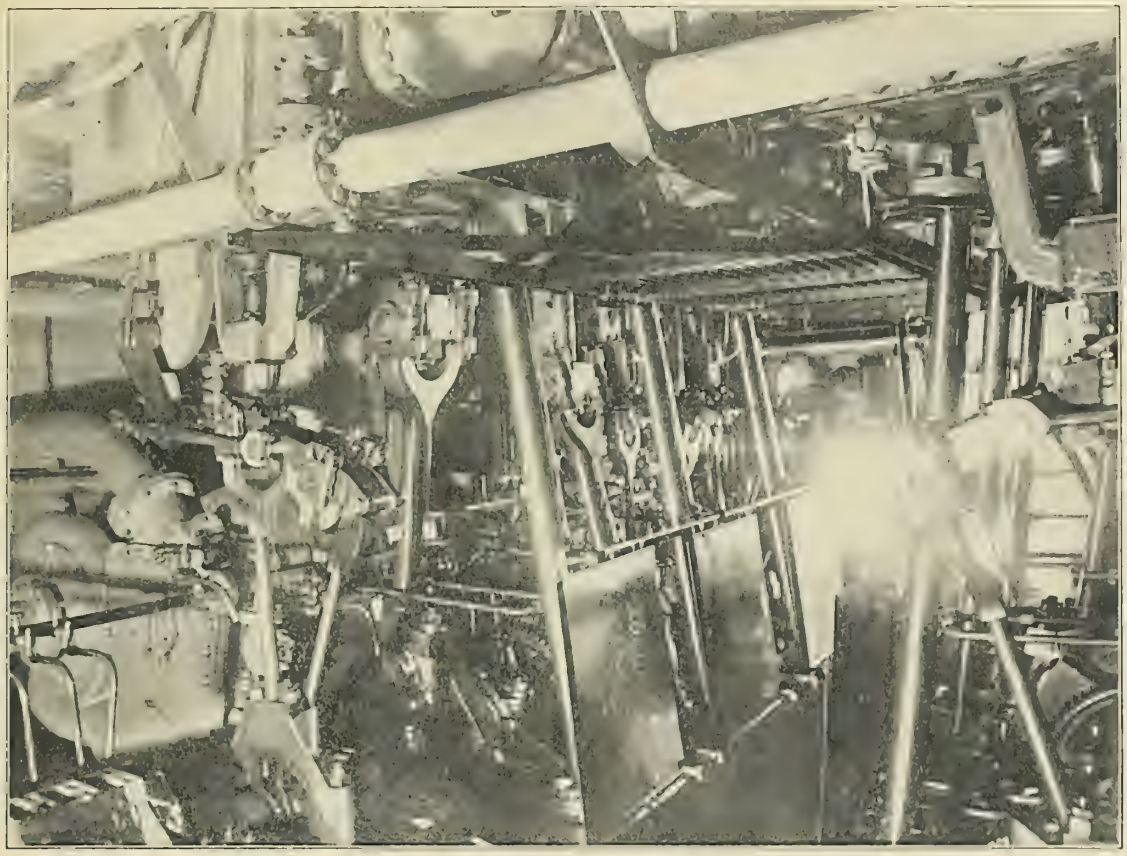
The boiler is covered with a casing consisting of 1-4-inch sheet asbestos, and outside of that a 1-inch sheet of non-conducting material, the whole protected by sections of light steel plates of such size as to be easily removable while the boiler is in place. There are two furnaces to each boiler, the shape of which is fixed by the arch of the tubes, and two doors to a furnace. The circulation of the water, generally speaking, is up the small curved tubes to the steam drum and then down the water tubes to the water drum. The boiler tubes are of solid drawn steel. The boilers are placed fore and aft, in one water-tight compartment abaft the engine, and there is one smoke stack for the two boilers.

Following are the principal boiler data:

Steam pressure at boilers, 200 pounds per square inch.


Transverse Metacentre
No. 10 Section 1 6 For'd of Dead Flat
Total Areas of Water Planes = 1 Sq. Ft. = 1 Ton
45° Line for C.B.
Tons per Inches Immersion = 10 Tons = 1 Ton
Wetted Surface 10 Sq. Ft. = 1 Ton
Displacement Fresh Water - 36 Cu. Ft. = 1 Ton
Displacement Salt Water - 35 Cu. Ft. = 1 Ton
Moment to Alter Trim 1 In. 1 Ton = 1 Foot Ton
Total Area Midship Section 1 Sq. Ft. = 1 Ton
About No. 10 Section
Centre Gravity of Water Planes 20 Tons = 1 Ft.
Centre Buoyancy above Base Line
Longitud. C.B.
Longitudinal Metacentre 2 Ft. = 1 Ton
25 Tons = 1 Ft.
About No. 10 Sec.
L.W.L.
L.W.L.
L.W.L.
Base Line
Scale for Mean Draught
Scale of Tons
Marine Engineering

CALCULATION CURVES FOR THE VIRGINIA.



VIEWS IN THE ENGINE AND BOILER ROOMS OF THE VIRGINIA.

Steam pressure at engines 200 pounds per square inch.
Number of boilers, 2.
Length of steam drum, 12 ft. 9 inches.
Width over casing, 11 ft. 0 inches.
Height over casing, 12 ft. 6 inches.
Steam drum diameter, inside, 37 inches.
Steam drum, thickness, 1 inch.
Furnaces, width of grate, two furnaces to each boiler, 6 ft. 9 inches.
Furnaces, length of grate, 7 ft. 0 inches.
Number of doors, 4 in each boiler.
Number of 1 1-8-inch tubes, 1,346 in each boiler.

Name—Virginia Nationality—American Type—Fast Propeller
Launched—1901 Builder—Wm. R. Trigg Co. Owner—C. & O. R. R. Co.

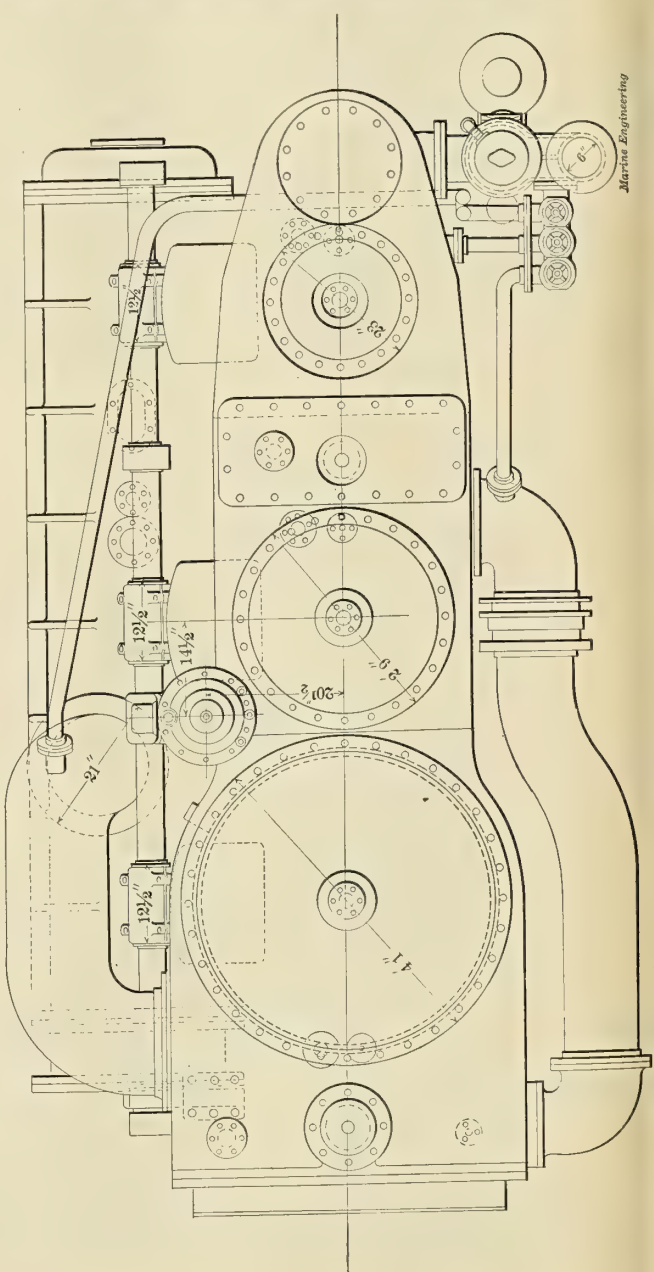
Length over all	200 ft.	Cylinders, diam	17, 27, 43 in.
Length between perpendiculars	192 ft.	Stroke	24 in.
Beam, extreme	33 ft. 5 in.	Designed R. P. M.	190
Beam, molded	32 ft.	" I. H. P.	2,500
Beam at load water line (9 ft.)	31 ft. 5 in.	" Speed (trial)	18¼ knots
Draft (sea-going condition)	9 ft.	Condens. Surf. (two condensers)	2,750 sq. ft.
Corresponding displacement including skin	693 tons	**Boilers**, number	2
Area immersed ⌖ to 9 ft. water line	213 sq. ft.	Type	Thornycroft Water Tube Daring
Tons per inch load water line	9.75	Steam pressure (at boilers and engines)	200 lbs.
Center of gravity of L.W.L. plane aft ⌖	5 ft.	Length of Steam Drum	12 ft. 9 in.
Center of buoyancy above top of keel	5 ft. 6½ in.	Inside Diam	37 in.
Center of buoyancy aft ⌖	1 ft	Width over casing	11 ft.
Number of frames	97	Height	12 ft. 6 in.
Coal bunker capacity	60 tons	Furnaces in each	2
Propellers, number of blades	3	G. S total	188 sq. ft.
Diameter	8 ft.	H. S. total	9118 sq. ft.
Pitch	11 ft. 9 in.	Draft	Closed fire-room system
Area	21 sq. ft.	H. S. ÷ G. S.	48.5
Engines, number of	2	H. S. ÷ I. H. P.	3.64
Type	3 cylinder triple	I. H. P. ÷ G. S.	13.3

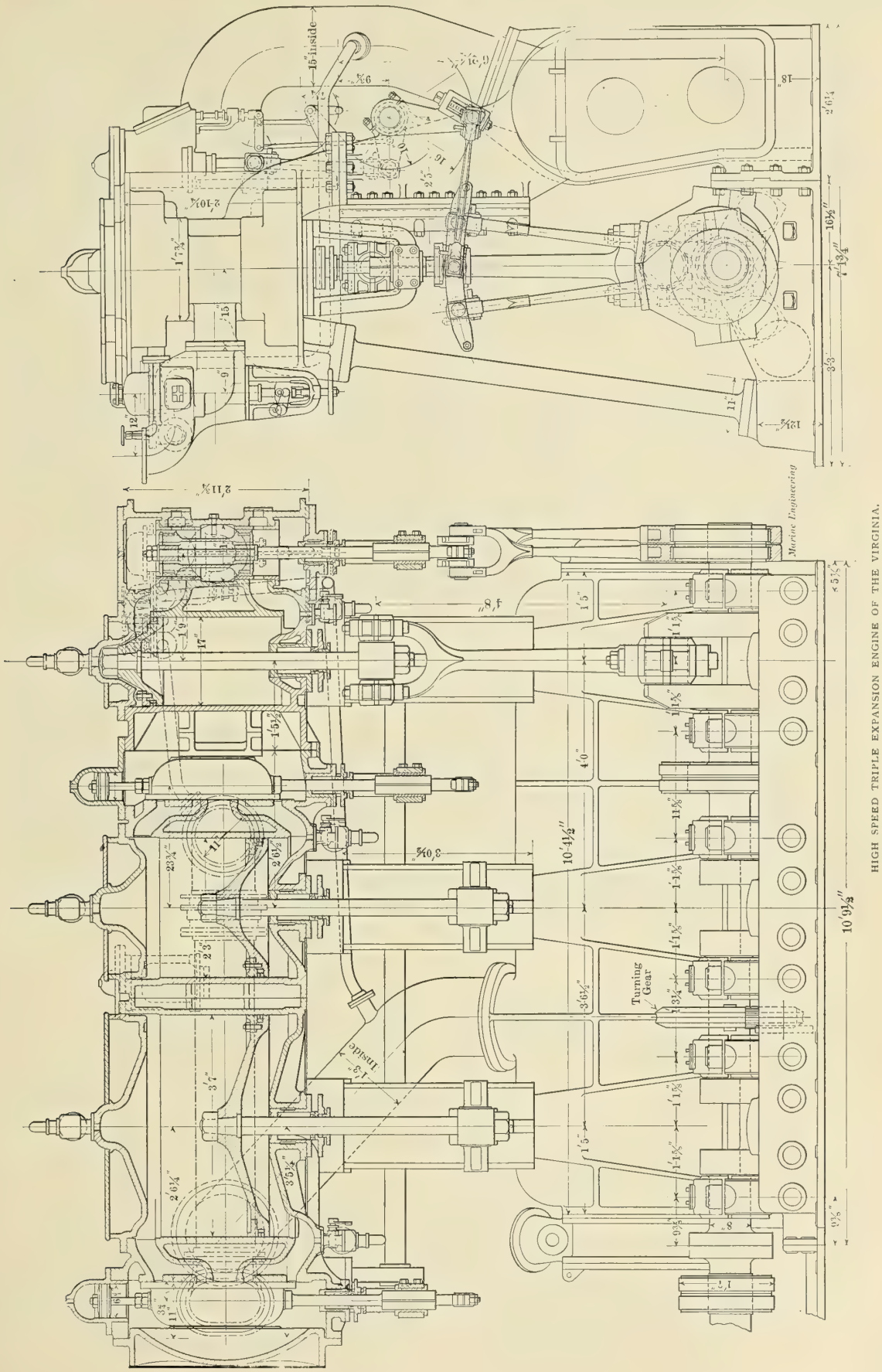
Number of 1 1-4-inch tubes, 372 in each boiler.
Thickness of tubes, 11 B. W. G.
Ratio heating surface to grate surface, 48.5 : 1.
Smoke pipe, oval section.
Smoke pipe, area 27 square feet.
Height above lower grate, 60 feet.
Safety valves, one on each boiler, 4 1-2 inches diameter.
Main stop valve, diameter 6 1-2 inches.
Total heating surface, two boilers, 9,118 square feet.
Total grate surface, two boilers, 188 square feet.
The closed fire room system of forced draft is used, the air being supplied by two blowers in the fire room. These were made by Mr. W. D. Forbes, and their performance was in every sense satisfactory. The fans are driven by simple enclosed engines, set horizontally. Following are the principal dimensions and data:

Fan, diameter ..... 54 inches
Width at rim ..... 14 inches
Diameter of induction nozzle ..... 36 inches
Revolutions to maintain air pressure of 1 1-2 inches .....800 per min.

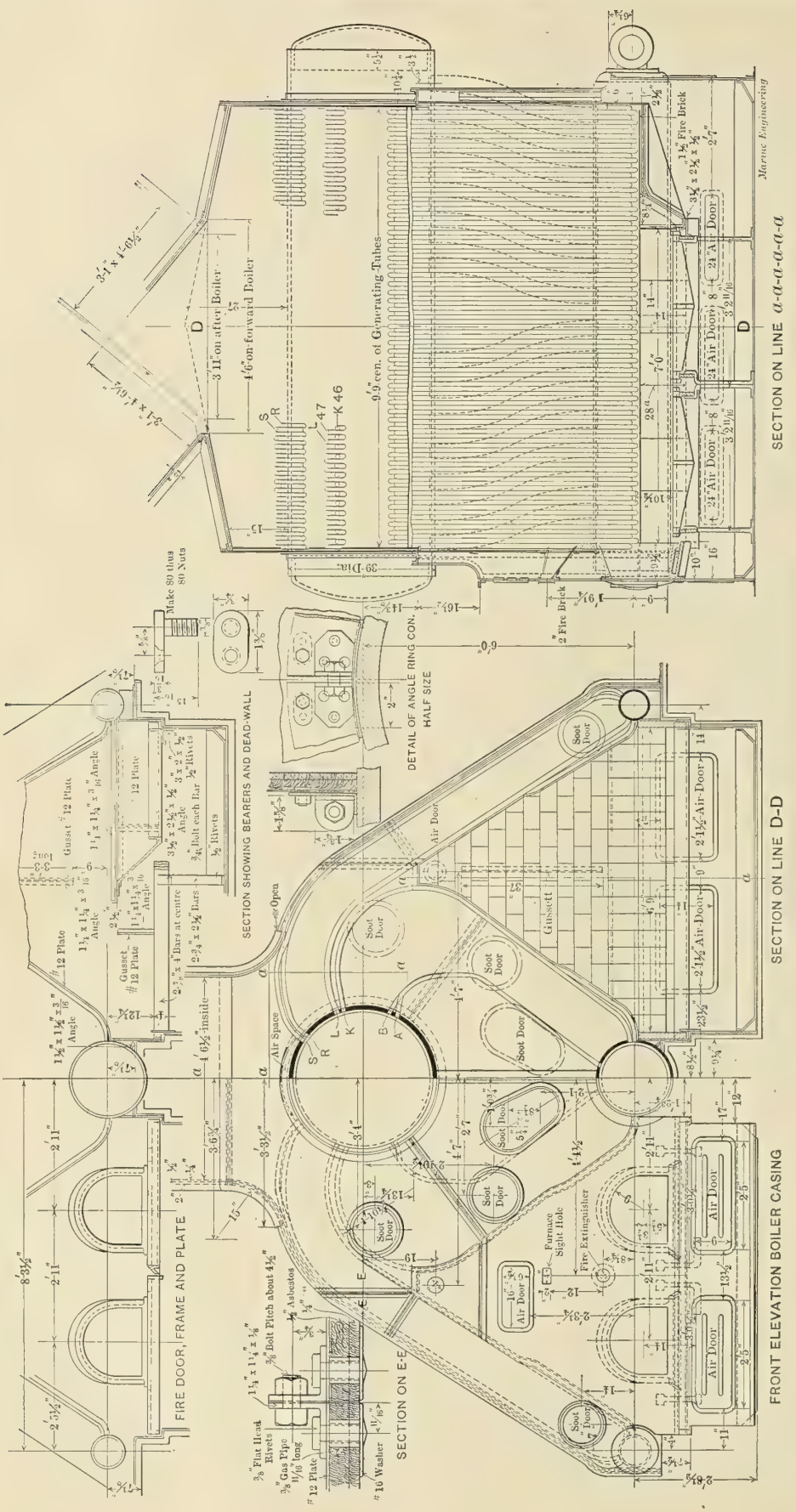
There is one main and one auxiliary Davidson feed pump, of the vertical, simplex, double-acting type. Both feed pumps are located in the engine room. The main feed pump draws from the feed tank and hotwell and delivers to the boilers. The auxiliary feed pump, which also acts as a fire pump, draws from the sea, bilge, feed tank, hotwell and ballast tank and delivers to boilers, overboard and to fire main.

There is one Davidson bilge pump, which draws





HIGH SPEED TRIPLE EXPANSION ENGINE OF THE VIRGINIA.


PLAN OF GRATE BARS, BEARERS, DEAD WALL, FIRE DOOR FRAME & PLATE.
FIRE DOOR, FRAME AND PLATE
SECTION SHOWING BEARERS AND DEAD-WALL
DETAIL OF ANGLE RING CON. HALF SIZE
SECTION ON E-E
FRONT ELEVATION BOILER CASING
SECTION ON LINE D-D
SECTION ON LINE a-a-a-a-a-a
THORNYCROFT WATER TUBE BOILER ON THE VIRGINIA.
Marine Engineering

from the bilge and ballast tank and delivers to fire main and overboard.

There is one Davidson sanitary pump, which draws from the sea and discharges to water-service and sanitary system. In addition there is one fresh water pump for wash purposes only.

There is one feed tank for the two engines, a part of the tank being fitted as a filter, into which the water flows from the air pump. The tank and filter have the following connections: Discharge pipe from feed pump, overflow pipe to bilge, suction to feed pump, vapor pipe and drains from traps. All places where

condensed steam can accumulate are fitted with drain pipes and traps, with discharge into feed pipes. The traps are provided with by-pass pipes and valves for convenience in overhauling the steering engine.

The chief deck auxiliaries are a steam windlass, Hyde hand capstan, with horizontal wild cat for 1-inch chain, and a Williamson steam steering gear, with double 5 by 5 1-2-inch engine.

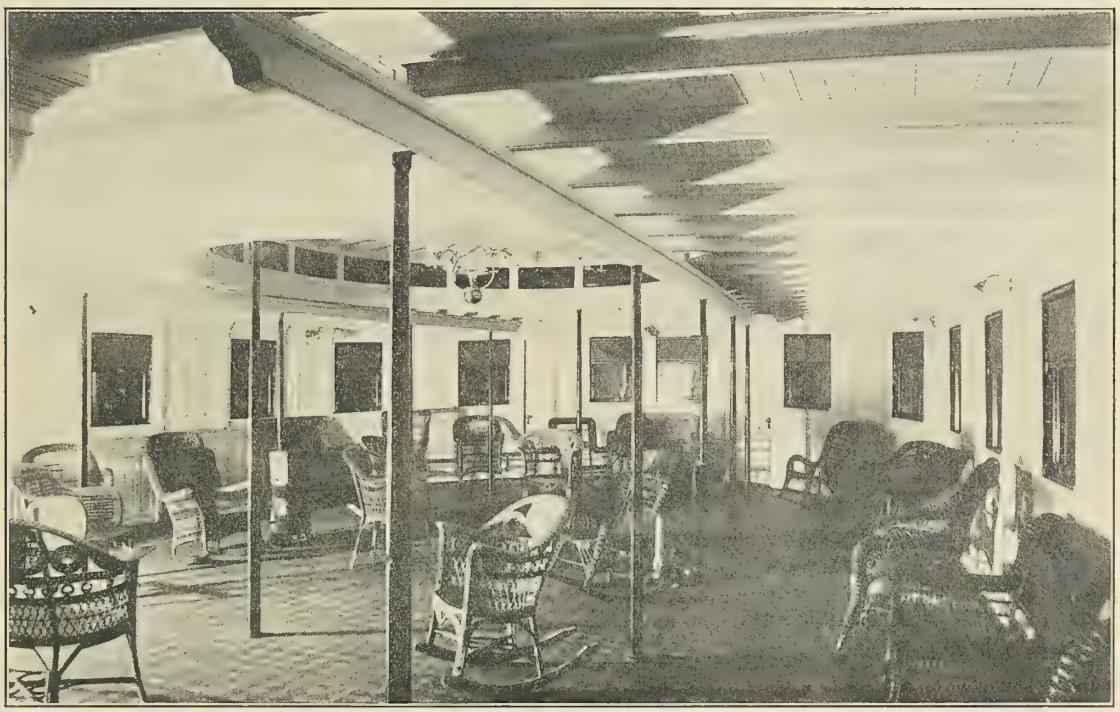
ELECTRIC LIGHT PLANT.

The electric light installation consists of 180 16-C. P. 110 volt lamps, which are supplied by a 10 K. W. direct-connected generating set of the General Electric make, which is located on the port side aft of the port engine. The generator leads are encased in iron conduit and lead direct to the main generator switch on the switchboard.

tight and decorative fixtures. The plant was thoroughly tested after the complete installation, and proved to be satisfactory in every respect.

The trial of the *Virginia* took place at the mouth of Chesapeake Bay on February 5, 1902. The trial was conducted by the William R. Trigg Company, who were represented by Mr. J. A. Nelson, general superintendent, and Mr. Thomas Jardine, superintendent of machinery. The Chesapeake and Ohio Railroad was represented by Captain Cooksey, superintendent of floating property, and Captain Warren, now captain of the *Virginia*. The weather was favorable and sea smooth. After a four-hour trial at full speed the boat was run over a measured course and maintained a speed of 18 1-2 knots, against a heavy tide.

The forced draft pressure was about two inches. The

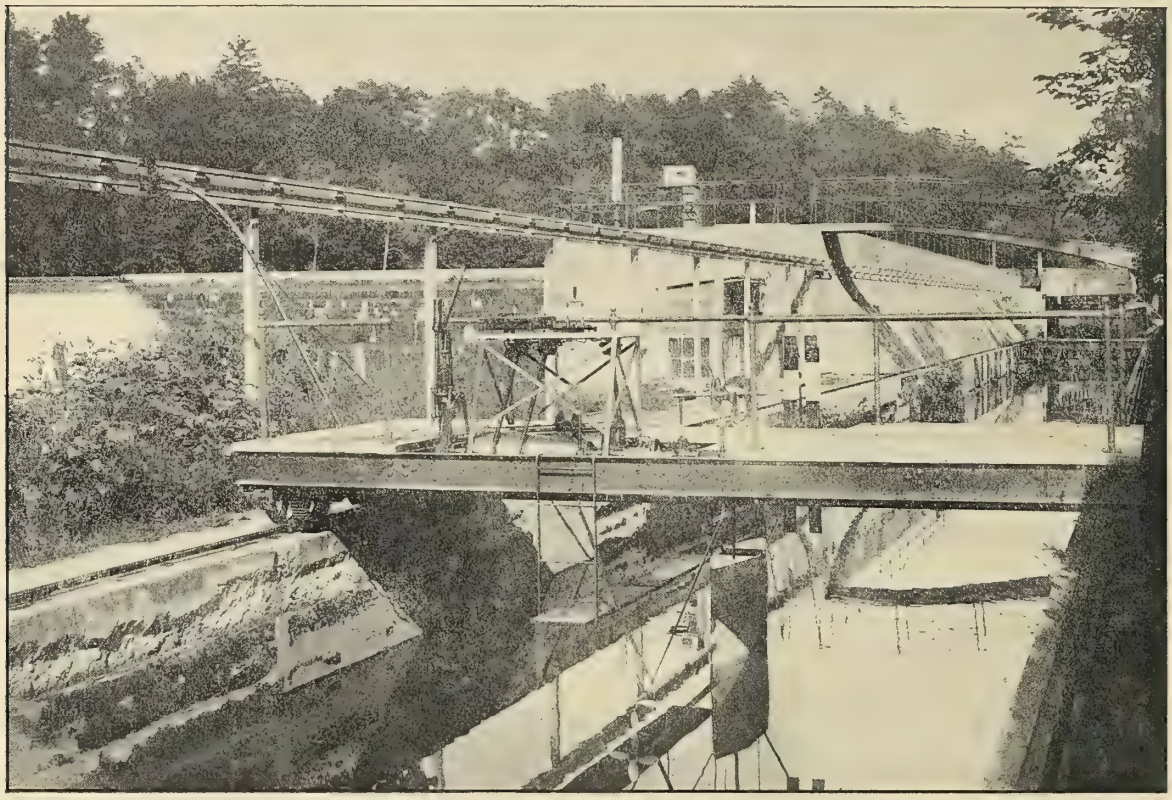


MAIN SALOON ON THE STEAMER VIRGINIA.

The switchboard is mounted on the bulkhead between the engine room and shaft alleys, supported by suitable iron brackets. The switchboard is made of 1 1-4-inch black enameled Vermont slate, and has mounted on it the necessary volt- and ammeters, generator and circuit switches, together with the pilot lamp fixtures and ground detector lamps. All wiring in the engine and fire rooms is encased in iron conduit, with water-tight junction boxes, and water-tight fixtures are used in connection with the lamps. A small panel board with several switches is mounted in the engine room, from which the various circuits feeding the engine and fire rooms are controlled. The main feeders from the switchboard to the various panel boards on the main, saloon and hurricane decks are also encased in iron conduit, which passes up through the engine enclosure. The wiring on the main, saloon and hurricane decks is in standard molding, and leads to the various water-

boilers steamed freely and steadily, the engines worked smoothly and all auxiliaries gave entire satisfaction. The trip was a success in every particular, and the company are to be congratulated on the sucess of their first merchant boat.

Steamship Thespis.—On December 23d the new steamship, *Thespis*, built by Sir Raylton Dixon and Company, Ltd., Middlesboro, England, to the order of Messrs. Lamport and Holt, made her official trial, and was accepted by the owners. The principal dimensions are: 390 feet length between perpendiculars, 50 feet breadth, by 29.6 feet molded depth, dead weight carrying capacity, 6,450 tons. She is built for the trade between Brazil, New York and Liverpool, and has handsome passenger accommodations for a limited number on the bridge deck amidships.



THE CORNELL UNIVERSITY EXPERIMENTAL CANAL.

EQUIPMENT FOR EXPERIMENTAL WORK ON RESISTANCE AND PROPULSION OF SHIPS INSTALLED AT THE HYDRAULIC LABORATORY OF CORNELL UNIVERSITY.

BY W. F. DURAND.

The new hydraulic laboratory of Cornell University installed in charge of the College of Civil Engineering possesses among other features a canal or tank about 340 feet in length by 16 feet wide and 10 feet deep. It is in part excavated through the shaly rock which prevails in the locality, and in part formed by walls of a special mixture of concrete. The surfaces of the canal wall are all faced with a layer of silica-cement from two to three inches in thickness.

The canal is provided with water from the reservoir above, through double shut off gates and an intermediate lock or measuring chamber. Once filled the water is quiescent and the level may be maintained where desired by an adjustable weir at the western end.

At the present time the canal is open to the weather. It is to be hoped that in the near future means may be found for covering it over and thus greatly extending the facilities for work. Through the courtesy of the College of Civil Engineering the facilities provided by this canal are open for the use of the School of Marine Construction for experimental research along lines of importance to this field of engineering work. The two chief lines of work which can be carried on in such a canal and which are of value to the science and art of marine construction are those relating to the resistance of ships and to their propulsion. The equipment thus far installed consists of the following leading features:

(1) A carriage or truck spanning the canal and carrying the propellers to be tested and the apparatus required, and running on a track extending the length of the canal.

(2) A transmission dynamometer for the measurement of the power absorbed by the propeller.

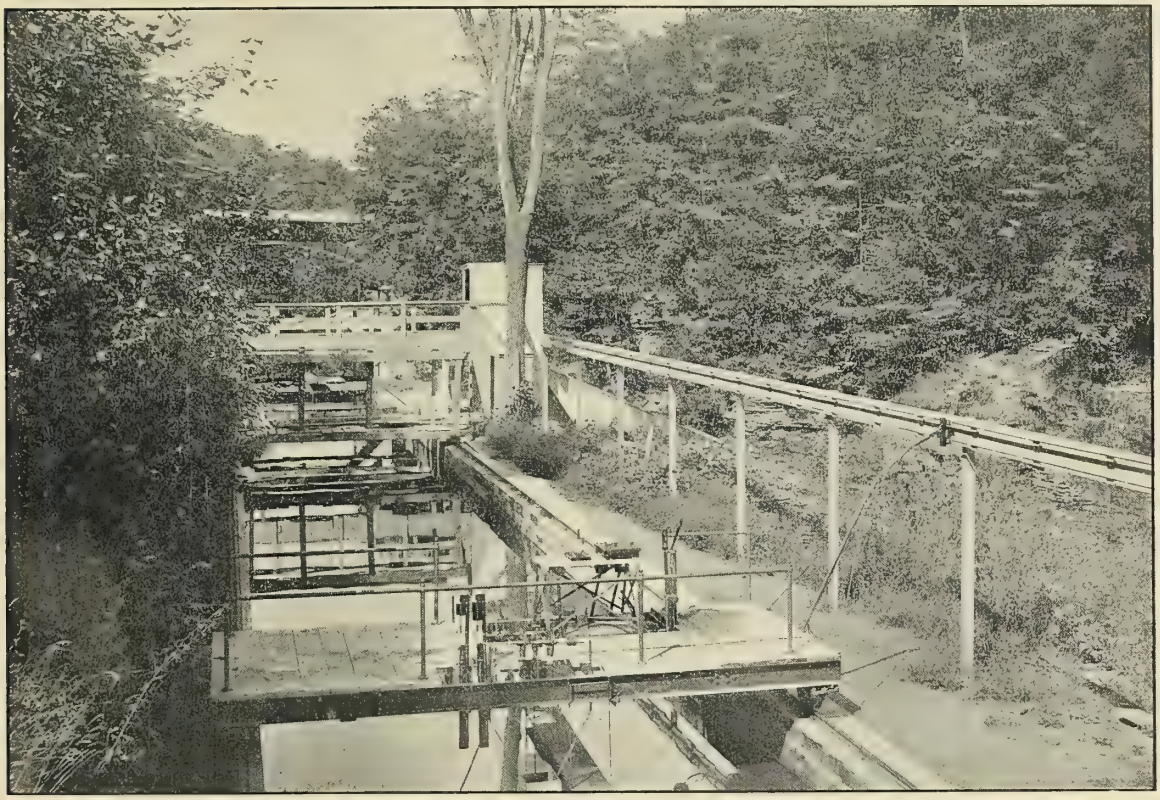
(3) Means for driving the propeller through the dynamometer at speeds varying through a wide range, and for any run in constant proportion to the speed of the truck along the rails.

(4) A thrust dynamometer for measuring the thrust developed.

(5) Means for registering time, distance, and revolutions.

CARRIAGE OR TRUCK.

This consists essentially of a platform about 8 by 18 feet, and carried primarily on two 10-inch steel channels spanning the canal, with two shorter I beams framed in between at each end, as shown on the general arrangement plans of Fig. 1. Between the latter are carried the wheels and motive power. The latter consists of one 15 H. P. electric motor geared down by a double reduction to the driving axle. The range of speeds at present contemplated is from about 100 to 800 feet per minute, or from about 1 to 8 knots. The speed of the motor is under control by means of a rheostat at the starting end and in circuit with the field coils of the generator in the power house. By means of this setting rheostat an adjustable E. M. F. can be readily provided



THE EXPERIMENTAL CANAL, LOOKING WEST.

at the motor, and thus any speed obtained within the limits provided.

For the more common range of speeds, 300 to 500 feet per minute, the distance required for acceleration is found not to exceed thirty to fifty feet.

TRANSMISSION DYNAMOMETER.

The form adopted is that used in the experiments previously made on Cayuga Lake and elsewhere described.* This consists of a special form of rope dynamometer as shown in Fig. 2. The rope leads around the driving sheave on the after end of the propeller shaft, the two parts passing over sheaves *H* and *I*, and then around the driving sheave *G*. These sheaves are all of the same diameter, in the present case 10 inches. The sheaves *H* and *I* are mounted with ball bearings on a shaft *PQ* which is carried by a block *LM*, the latter being connected to the base by a pair of thin plates of spring steel. This is the well known Emery support or substitute for a knife edge, and for slight movements is almost perfectly frictionless, at the same time affording rigidity in the directions desired. The sheaves *H* and *I* and their shaft thus form a balanced rocking system or lever pivoted in the middle and therefore without deflection so long as the tension of the rope on the two sides is the same. When running, however, the difference between the tensions on the tight and loose sides determines a moment which tends to throw this arm down. The downward thrust is then measured either by a spring dynamometer, or by specially designed hydraulic step connected to a mercury manometer.

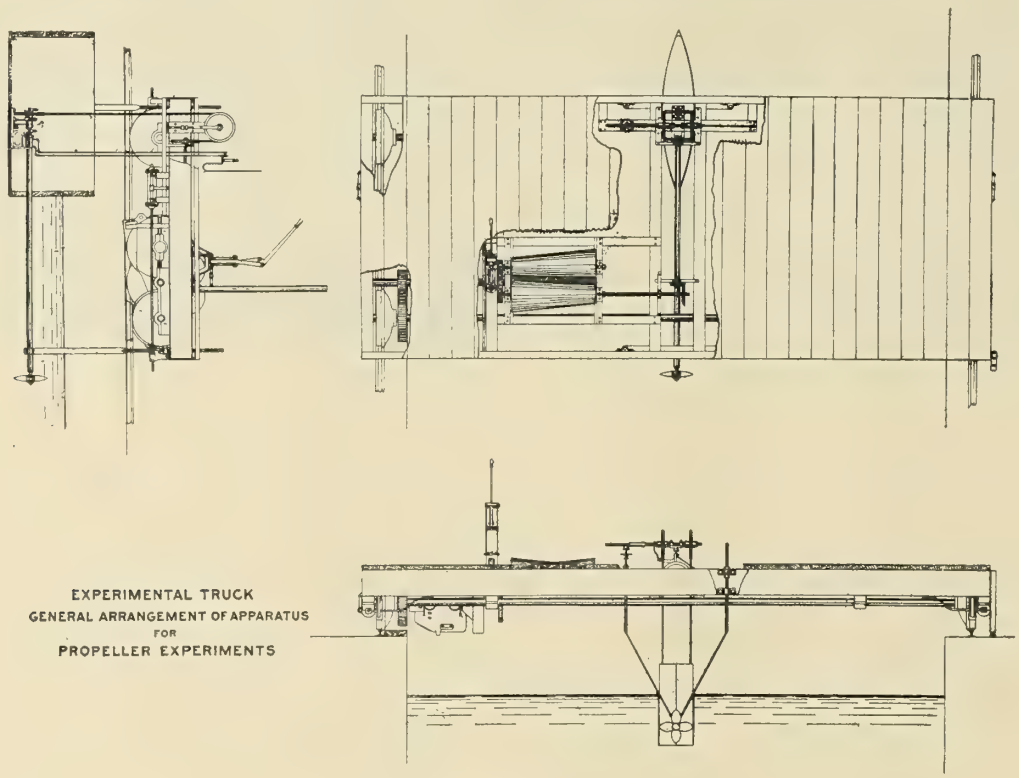
A is a cylinder with plunger fitted with extra care so as to work with small leakage of oil and almost perfect absence of metallic contact. The head of the plunger rod is spherical and is connected to the rocking shaft through the socket *B* which provides a ball-bearing rest for the spherical head and thus entire absence of angular constraint between the two. The base of the cylinder *A* is also carried on a flexible support so that any slight angular movement which may be given to it as a result of the up and down motion of *B* will be free from all constraint. The downward thrust of the shaft *PQ* is thus transmitted to the plunger and thence to the oil in the lower part of the cylinder the pressure of which is read or registered by an ordinary open mercury manometer. The movement of the shaft *PQ* is limited by stops to about ¼ inch on either side of the position of equilibrium. A hand pump is connected up for supplying oil to the cylinder, and this together with an overflow make it an easy matter to keep the shaft floating between the stops during the runs. In order to remove any residual frictional resistance to the longitudinal movement of the plunger in the cylinder, the plunger rod is provided with a means for rotating it on its axis either by hand when reading, or automatically, such motion being allowed by the spherical joint at the top of the rod as referred to above. By this means a very delicate measure of the forces is obtained, the reading being the height of the mercury column which may reach values of 12 to 15 inches or more. The location of

* Proceedings Society of Naval Architects and Marine Engineers, Vol. V, page 107.

the arrangement relative to the shaft *PQ* is adjustable so that the capacity of the dynamometer may be increased with the same range of reading by lengthening the effective arm of the plunger about the axis of the rocking couple.

The indications of the dynamometer are connected with the actual forces through a calibration by means of a prony brake placed on the propeller shaft in lieu of the propeller. For this purpose the water in the canal is drawn down leaving the brake out of water, and thus convenient for manipulation. All friction of the bearings in the dynamometers, small as it may be, is thus eliminated, and experience with this form of dynamometer shows that the indications are very delicate and accurate and the calibration constant.

HI engaging with those on the plunger rod. The connection between these pairs of arms is by means of a pair of small steel rollers carried by the arms *HI* and resting on *EF*. These rollers are carried also in ball bearings and the rollers are so adjusted that forward and backward motion of the plunger and rod is allowed by the rolling of the surfaces of one pair of arms on the rollers carried on the other pair. The torque is thus transmitted from the driving pulley to the plunger rod, with perfect freedom for the latter to move longitudinally back and forth. These various parts are carried in a small caisson or boat pointed fore and aft and hung from the truck by adjusting bolts, as shown in Fig. 1. The shaft, which is about 8 feet in length, is carried in a pipe to the forward support shown in the side ele-



EXPERIMENTAL TRUCK
GENERAL ARRANGEMENT OF APPARATUS
FOR
PROPELLER EXPERIMENTS

FIG. 1.

VARIABLE SPEED CONTROL.

This is effected by driving the propellers through the transmission dynamometer by a shaft connected through an Evans friction cone and appropriate gearing to the motor. The general arrangement of these features is shown in Fig. 1. By means of a single change of gears and the friction cone, a range of revolution from about 120 to 700 at a speed of about 300 feet per minute is thus provided for.

THRUST DYNAMOMETER.

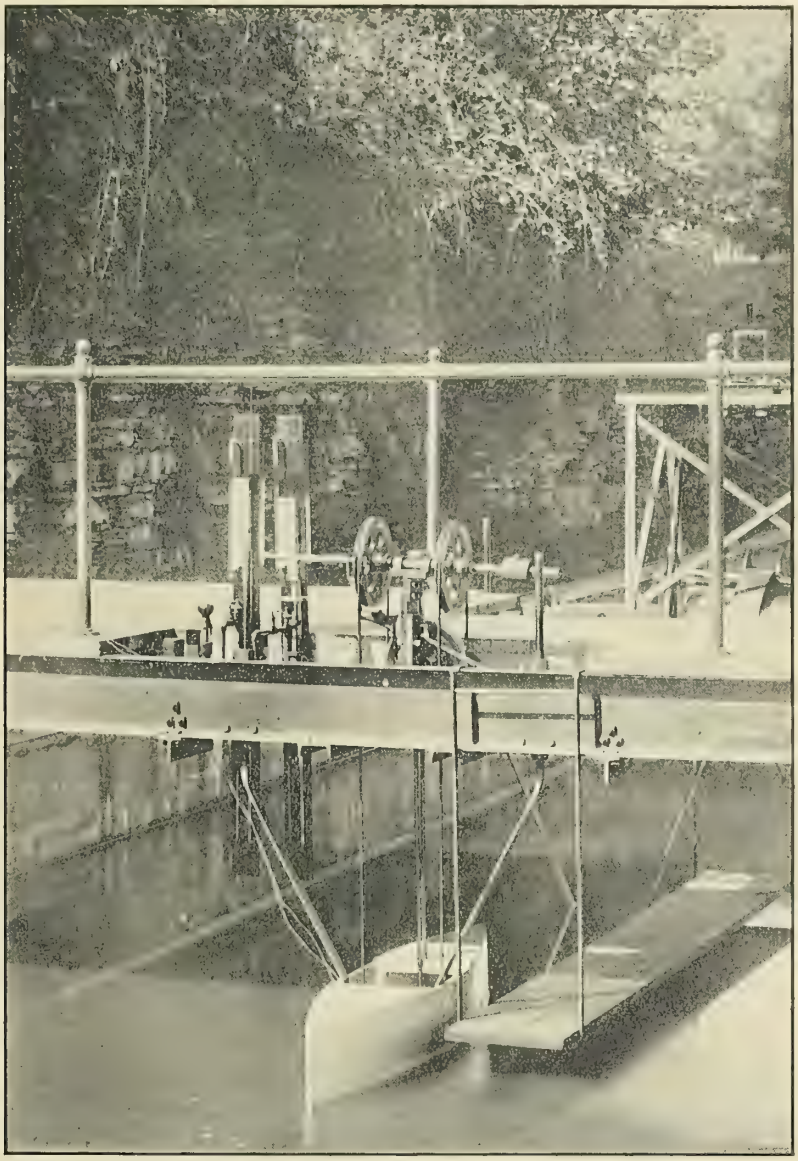
The thrust dynamometer is shown in Fig. 3 and consists of a cylinder *A* with plunger *B* to the rod of which is coupled the propeller shaft *C*. The plunger rod is also continued backward as shown at *D*, and carries a pair of driving arms *EF*. The driving pulley *G* is carried on a shaft running in ball bearings as shown. The forward part of the shaft carries a second pair of arms

vation of Fig. 1. Here the pipe carries a ball bearing on which the shaft rotates and moves longitudinally as may be required. The other bearings are distributed as shown and the cylinder *A* Fig. 3 is simply supported between the two vertical faces of the base plate.

The plunger and rod with propeller shaft attached is thus free to move back and forth without constraint from its surroundings. In operation the propeller is run at a number of revolutions relative to the speed of advance which will give it a positive slip, and thus a pull forward. The cylinder forward of the plunger is filled with oil connected to an open mercury manometer, and the forward pull developed by the propeller is thus opposed by the pressure of the oil, and the manometer becomes thus a means for measuring the force as desired. The space behind the plunger is also filled with oil under pressure from a stand pipe with a small res-

ervoir on the upper end, and at the height of the manometer. This balances the column of oil in the pipe between the manometer and the cylinder and leaves the mercury in the former free to record simply the forces developed by the propeller. A small hand pump is provided for forcing oil in forward of the plunger, as well as an overflow for allowing it to escape, so that between the two the location of the plunger may be adjusted as desired, and leakage of oil may be made up as necessary. The motion of rotation eliminates practically all frictional resistance to the longitudinal motion of the shaft, so that all of the pull developed by the propeller is transmitted to the oil, and the apparatus as a whole is found to provide an extraordinarily delicate and accurate measure of the forces involved.

The indications of the dynamometer are connected with the actual forces through a calibration effected by the use of a bent lever fitted with a knife-edge bearing, one arm of the lever being horizontal and the other vertical. To the former are hung known weights, while the end of the latter presses against the plunger shaft through an intermediate steel rod passed through a hole in the shaft of the driving wheel *G*. The shaft being then rotated, known weights are placed on the horizontal arm, thus producing known pressures axially on the plunger shaft. These pressures are measured by the manometer in the usual manner, and in this way its indications are connected with the actual forces in play.



THE CAR AND FLOAT.

The automatic registration of the forces in both the power and thrust dynamometers is made by means of a special type of open end mercury manometer as already referred to above. The indications of the mercury column are registered by the use of an aluminum float carrying a slender steel rod moving in guides, and to which is attached a light pen carriage and pen. The latter is held by a very light spring against the paper,

and the whole is free to rise and fall in answer to the movement of the column of mercury. In practice it is found that this form of recording device is reliable and sensitive, and that it can be depended upon to respond with certainty to the movements of the mercury column. The vertical drum carrying the paper is given motion from the driving axle so reduced as to revolve once for a complete run over the course. The indications of the manometers are thus recorded on a distance abscissa and show the history of the variation of the forces throughout the entire course of the run.

RECORDS OF TIME, DISTANCE AND REVOLUTIONS.

These records are all made by a chronograph of special form and recorded on a strip of moving paper. The time signals are furnished by a clock with electric seconds break attachment. The distance marks are given by an electric contact arrangement along the rails, and the revolutions by an electric contact attachment counting every fifth revolution of the propeller shaft.

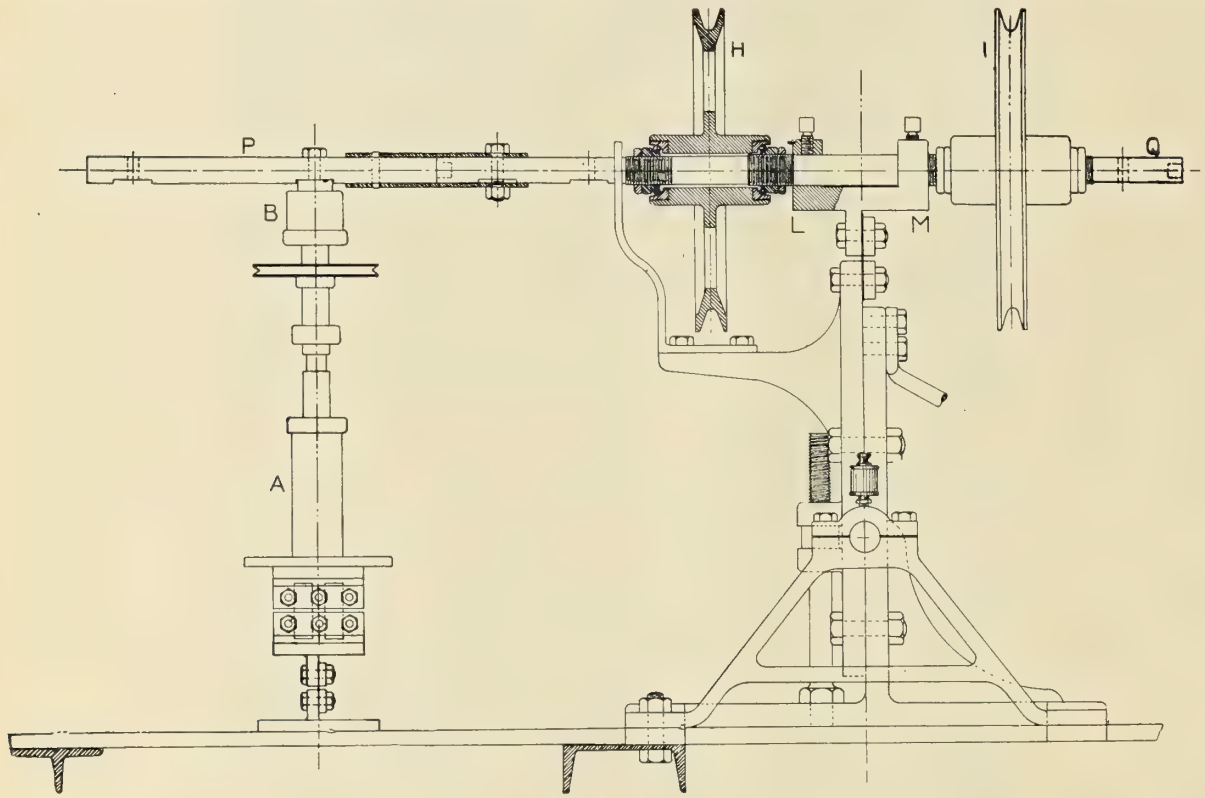


FIG. 2.

SPECIAL PURPOSE OF THE EQUIPMENT.

Problems arise in all branches of engineering work which cannot be properly investigated without the aid of experimental investigation. Nowhere is this more fully realized than in the field which is concerned with the design of ships and their propelling machinery, and with all the problems met with in this field, none is of higher importance or more completely dependent upon experimental investigation than those which arise in connection with questions of resistance and propulsion. It is indeed a fact that notwithstanding the enormous advances made by the science of mathematics, it is still entirely unable to deal with the problem of the forces concerned in the motion of a body through a liquid. These forces depend on so many variable conditions, and are related to these conditions in such obscure ways, that at present all attempts at a full mathematical discussion of the problem seems out of the question. The only method is, therefore, to investigate the problem experimentally in such way as shall best answer the needs of the case in hand.

In a general way such investigation might be of two kinds—direct or indirect. In the first the objects to be investigated are represented full size, and all the conditions of the problem are reproduced as nearly as may be, and the results noted. Thus we might determine the resistance of a torpedo boat by building the boat full size and then towing it at varying speeds and noting the resistance with a traction dynamometer. Or again the performance of a screw propeller might be examined experimentally by building the propeller full size, producing the conditions of use, and noting the forces developed. From the labor and expense connected with experiments on such a scale it is but rarely that they can be carried on in this manner, and if there were no other way, the application of experimental methods would be of limited use.

In fact the important feature in all experimental work of the kind we are now considering lies in the fact that the data for any one case may by appropriate laws be applied to an indefinite number of other cases, and thus its value as an observation indefinitely extended. The laws which govern this relationship being accepted as a

working basis, it becomes possible to represent the object under investigation by a comparatively small model. The latter is then made the subject of a direct examination under suitably related conditions, and the results thus found may then by means of the laws of comparison be used to determine the results for the full-sized body used under the conditions proposed. But this does not necessarily end the usefulness of the results thus found. Having served its immediate purpose it may be filed away for future use and may then be made to serve, as occasion arises, for an indefinite series of other similar problems under suitably related conditions. We shall not here enter into these laws of relation and comparison. It will be sufficient to note simply that their object is to render as far as possible the investigation independent of size or dimension, so that the series of cases referred to above may consist of an indefinite series of sizes, all of the same form and proportions, and operated under speeds related to that of the original model. With this by way of general introduction we may note briefly some of the important problems which such an equipment is able to aid in solving:

What size and form of propeller is suited to a given ship at a given speed?

What revolutions and speed might be expected of a given propeller fitted to propel a given ship?

How much surface can be given to a proposed propeller under stated conditions?

What is the relative efficiency of a propeller backing and going ahead?

What is the best combination of propellers as regards pitch ratio and distance apart, in the case of more than one propeller on the same shaft?

What is the least diameter of propeller that can be safely depended on to efficiently absorb a given amount of power under stated conditions?

What will be the effect in any given case of keeping steam pressure the same and slightly changing the pitch of the blades? etc., etc.

With slight additions to the equipment described above it will be possible to extend the range of investigation to cover the resistance of ship models and to aid in answering such questions as the following:

What is the resistance of a proposed ship at a given speed, and how much power will be required to drive her at such speed?

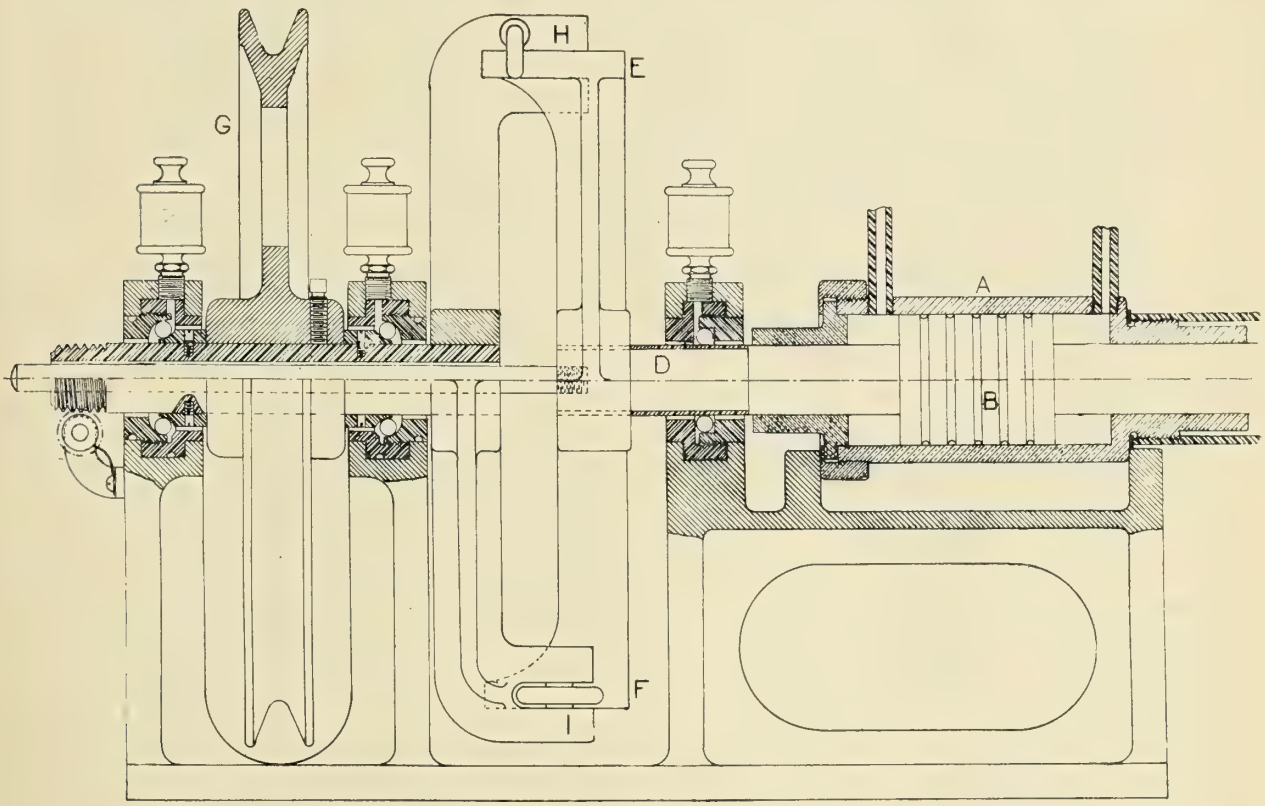


FIG. 3.

Which of two or more models proposed will require the least power at a given speed?

What type of propeller is best suited to a given or proposed model of ship?

What effect on the resistance of the ship will be produced by changing the location of the propeller nearer or farther from the stern post?

What effect will shallow water have on the power required to maintain any proposed speed with a given model? etc., etc.

The lines of experimental research which we have thus far noted are those directly connected with commercial questions. There is in addition a large field of work of the very highest importance and which has been but imperfectly worked over. This consists of the more fundamental problems connected with the forces acting

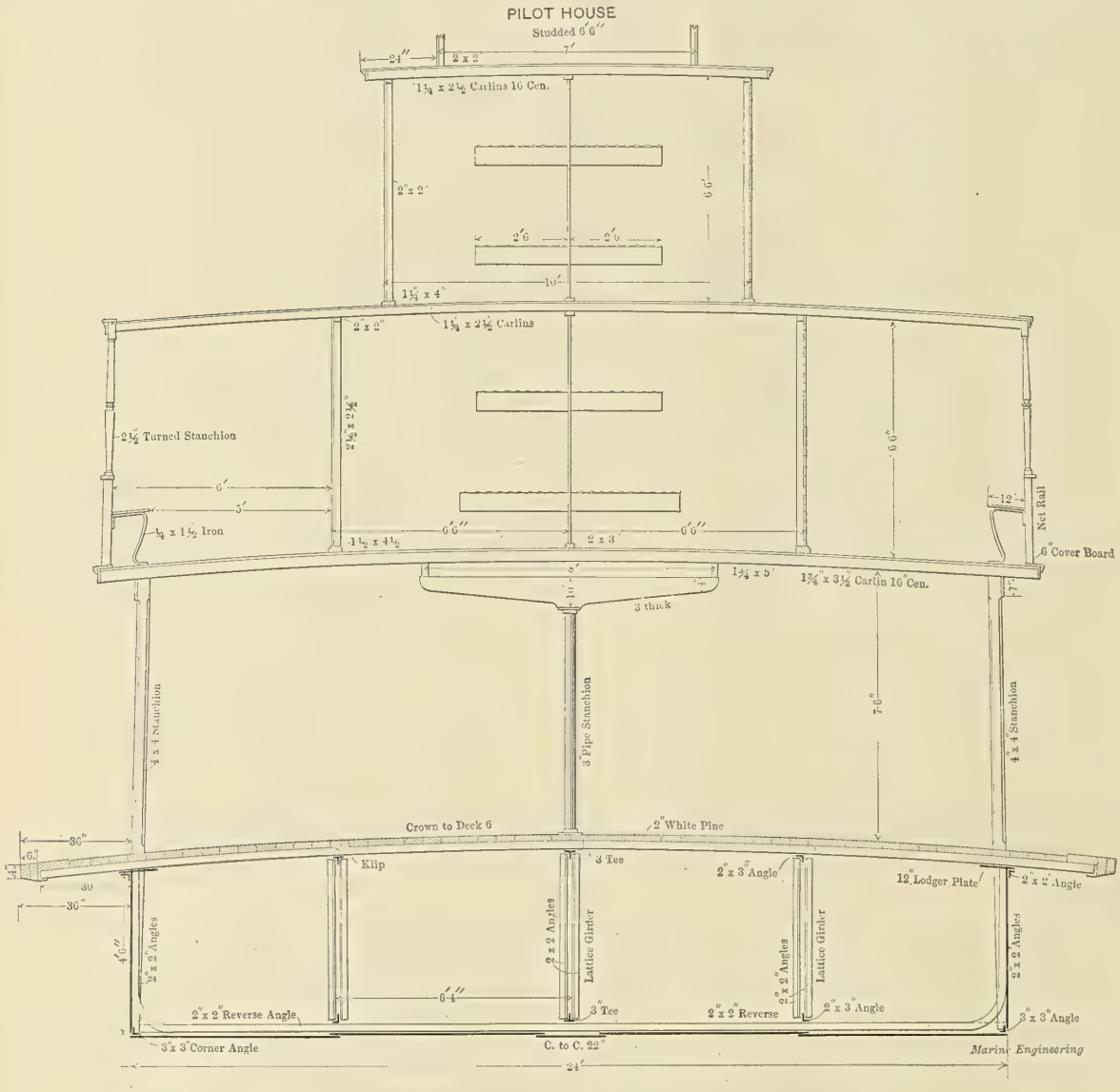
on bodies of elementary forms under varying conditions, such, for example, as planes of varying size and form moved at varying speeds, immersions, and angles of obliquity with the course. Likewise bodies of elementary form, such as the section of a propeller blade moved under varying conditions. There is in these and allied problems a vast field of work not related to any one commercial problem, but related to them all and to the whole subject in a very important and fundamental way. From the scientific standpoint, therefore, no work is at present more needed than a thorough and comprehensive examination of many of these questions, and no great advance in our theories of hydrodynamics as applied to such problems is likely to be made until the results of such investigations become available.

The programme of possible and really important work of this character which may and which should be done is so large that there will be no trouble in utilizing all the time and capital which can be found for the prosecution of these and allied lines of work.

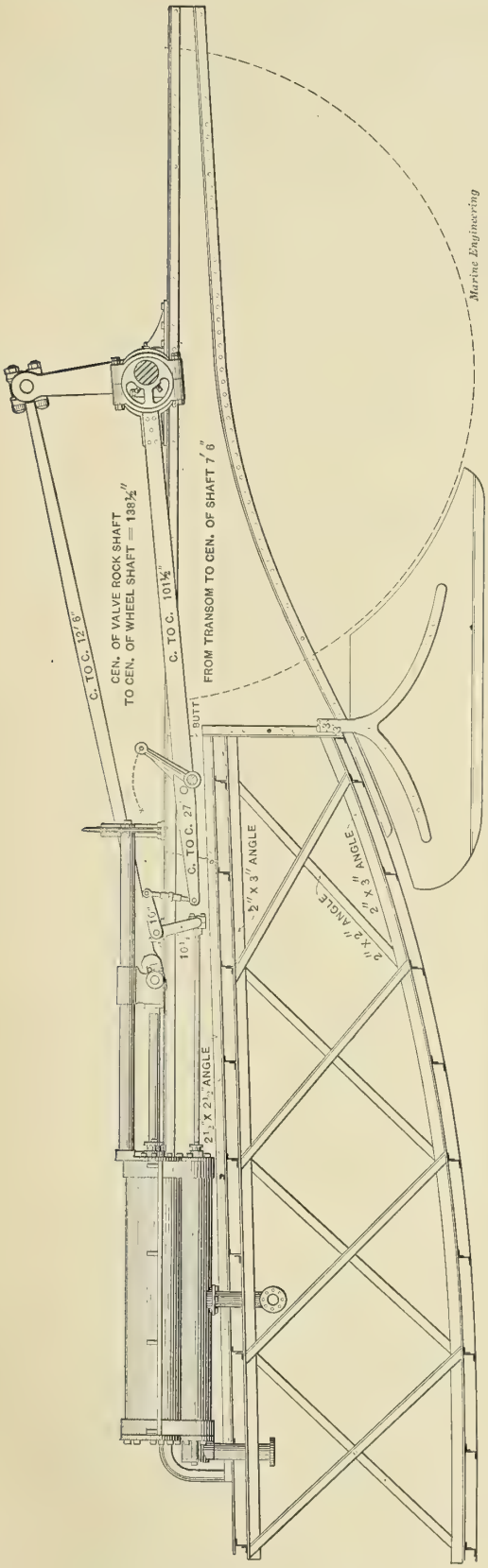
Stern Wheel River Steamer.

The fine steel stern wheel river steamer, the *City of Fayetteville*, has recently been completed by the Merrill-Stevens Engineering Company, Jacksonville, Fla., for service on the Cape Fear River of North Carolina. In the construction of this boat many novel ideas have been used, and she represents the latest type of shallow draft river steamer.

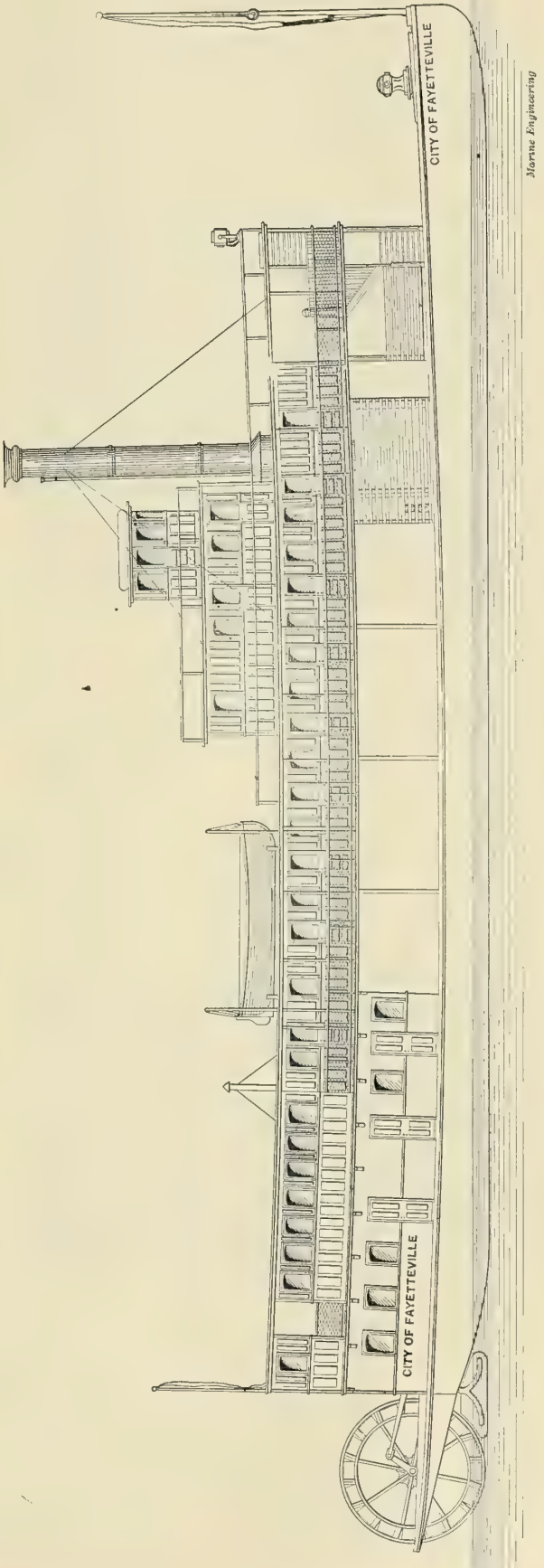
The hull is 125 feet long, and, including the transom at the stern, is 140 feet over all, the molded beam is 24 feet, the beam over all 30 feet, and the depth is 4 feet. The general construction is shown in the midship section and other views. To make the shallow hull sufficiently strong to support the weight of the engine at one end and the boilers at the other, the intervening space being filled with cargo, special fore and aft stiffening is fitted. This is supplied by three lattice girders, one on the center line and one on either side 6 ft. 4 in. from the center. These girders extend from the stern to the forward collision bulkhead, the center one to the



MIDSHIP SECTION OF STERN WHEEL RIVER STEAMER BUILT BY THE MERRILL—STEVENS ENGINEERING COMPANY.



HIGH PRESSURE ENGINE FOR STERN WHEEL STEAMER AND ENGINE FOUNDATION.

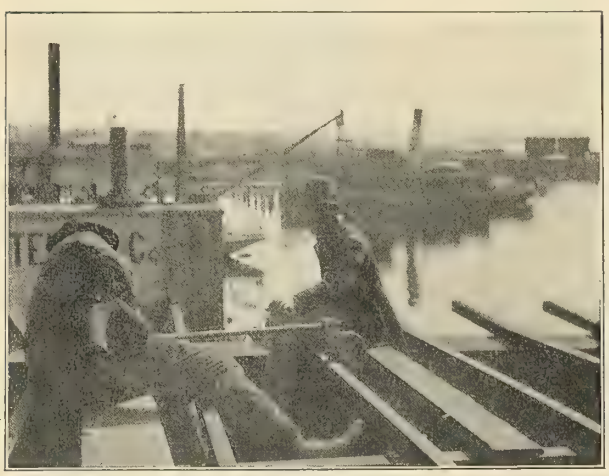


STERN WHEEL STEAMER CITY OF FAYETTEVILLE FOR NAVIGATION ON THE CAPE FEAR RIVER, N. C.

stem. In navigating shallow streams it has been found that the greatest wear of the hull is at the turn of the bilge, and to remove the bilge plates requires much time and expense. In this vessel, as well as other recent ones of this type, the bilge is made square and at the knuckle is run a 3 by 3 by 1-4 inch angle along the in-

SHOWING GENERAL CONSTRUCTION OF RIVER STEAMER.

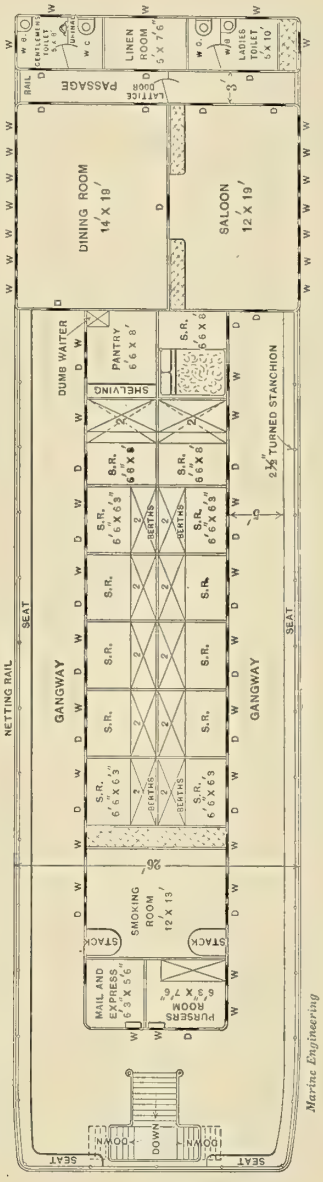
side of the plates all fore and aft; this angle takes all the wear and can be replaced at small expense. The construction of the girder is shown on page 281 with the view of the engine. The frames are made in one piece



PUNCHING DECK BEAMS BY HAND.

from side to side. The reverse angles run from knuckle to knuckle and are 2 by 2 by 3-16 inch. Deck beams are placed on every frame and are 2 1-2 by 2 1-2 by 1-4 inch angles. The hull is divided by four watertight bulkheads of 7 1-2 pound plating, and the lattice girders are intercostal between bulkheads.

At the forward end of the main deck are two water-tube boilers 7 by 9 feet each carrying steam at 200 pounds pressure. In the after deck-houses are accommodations for the crew, and the engine room. The stern wheel is driven by two high-pressure engines each 12 inches diameter by 60 inches stroke. The piston valve which is placed below each cylinder is 5 inches in diameter and is operated from the eccentric as shown. The engine and wheel are mounted upon a heavy tran-



SALOON DECK OF CITY OF FAYETTEVILLE.

som frame which is riveted to the deck and after bulkhead. The crosshead is carried by two wrought iron slides supported by the head of the cylinder and a bracket at the after end. The valve motion is controlled by the reversing lever, which swings through the arc X. This system of gear and arrangement of the valve below the cylinder is a distinctive feature of the Merrill-Stevens engine and has given great satisfaction. Its simplicity is apparent. In the engine room are mounted the various auxiliaries, including a small

direct driven dynamo. At the bow is placed a steam windlass. The vessel is steered by two balanced rudders with rudder stock running down the outside of the after bulkhead and supported by the transom. The two quadrants are yoked together above the deck and the steering gear leads to the pilot house. The stern wheel is made up of wrought iron rings and is 13 feet 6 inches diameter by 16 feet face.

The accommodations for passengers on the saloon deck are found to be much more commodious than usual in this type of boat. Forward are the mail, purser's room and smoking room, and then come ten staterooms 6 feet 6 inches by 6 feet 3 inches, and three larger staterooms. At the after end are the pantry, dining-room, social hall, lavatories and lockers. Above the saloon deck-house are the captain's and pilot's rooms, and above them, behind the two stacks, is located the pilot-house.

The designers have thus been able to build a complete steamboat, which, when loaded, will only draw 18 inches of water and will be capable of making a speed at 40 revolutions of the engines of 14 miles an hour.

REFRIGERATION ON SHIPBOARD.—II.
Points on Design.

BY E. N. PERCY.

Beginning at the source of power, which is usually a steam engine, it should be so designed as to operate the compressor at 70 to 120 strokes per minute. We assume an ammonia compression system to be used, as it is the preferred system today. The tendency, or at least the hope is among marine engine designers, to find some practical method, other than steam, of operating all of the auxiliary machinery. Three principal systems of transmission present themselves; they are electricity, air and hydraulic service. The near future may see our refrigerating plants driven by any one of these systems. The principal object of these efforts is to increase the economy of a very uneconomical class of machinery. The average refrigerating machine comes under this head with emphasis, when driven by a cheap steam engine. Not long ago, one of our naval engineers made an investigation of the economy of auxiliary steam engines. He was astonished at the amount of steam wasted by them. I do not recollect that his report mentioned refrigerating machinery, but it showed the importance of economy of the auxiliary machinery in general.

Taking the steam engine as generally applied to refrigeration, it should be solidly designed, with ample bearing surface, heavy flywheels and proportioned for shocks and stresses, due to the various demands of ammonia compression. The compressor may be connected tandem with the engine, or may be connected to another crank upon the same shaft. The latter way is preferable, as the balance wheel need not be so heavy, because the cranks can be so arranged as to have the engine turning moment at its maximum when the compressor is at the point of greatest resistance. The former way is the cheaper, but not to be recommended for economy or easy running.

Designers have seen fit to apply compound engines to generators, pumps and air compressors; why not apply them to the refrigerating plant? It would result in marked economy and smoother running. The double-acting compressors often give trouble by leaking at the rods. This seems to point either to using one large or two small single-acting compressors. Still, it seems as though double-acting compressors ought to work successfully if carefully constructed, and the oil seal glands designed with ample proportions, as the large machines of this class work well; but this necessitates a long machine, which is always more unhandy than two cylinders close side by side.

The enclosed type of compressor is very popular, as the crank pit can be connected with the suction of the compressor, and the shaft enclosed in a long stuffing box without oil seal, as a rule. This form, as usually made, while eliminating the leakage of ammonia, is open to many objections. Usually, the cover is on the side opposite the main bearing, necessitating an over-hung crank and a yoke, both of which are unsatisfactory in operation; and repairs can only be effected with much discomfort and loss of ammonia.

The proper proportions of the volumes and piping is a subject too complex to touch upon in this article, but in general, too little attention is paid to these points with small machinery of this class, and thus many a pound of coal has gone to waste. Throttle governors are usually used with these engines. A very successful form is a sensitive diaphragm governor attached to a butterfly valve, and operated by the pressure in the freezing coils; but in all cases, the regulation of the engine must be arranged so as to be instantly changed by hand.

If the brine and circulating pumps are attached directly to the engine and compressor, additional economy is realized, and the plant is simplified in piping and less floor space is required. With this arrangement, the plant must be started cautiously, and the expansion and compressor suction valves only opened enough to prevent a vacuum, until the brine and condenser water circulate freely.

If horizontal compressors are used, they should have horizontal valves, as vertical or oblique valves are bound to give trouble by wearing elliptical in time, and a very small leak suffices to displace the piston, and seriously reduce the efficiency of the compressor. In the best compressors, the whole head can lift like a large valve, in case the pressure becomes excessive, or oil or liquid ammonia gets on top of the piston. In oil injection machines this is a necessity to save occasional broken heads. The machine should be provided with an oil separator of ample capacity. It should be so designed as to prevent the oil foaming up, and being carried over into the condenser, and thus reducing its efficiency. There should also be a lime vessel to remove any moisture from the ammonia. This should be cleaned regularly. A by-pass with shut off valves should be provided so that the machine need not be shut down. Few machines on ships have this contrivance, yet it is most necessary, as water will get in from lubricating oils, from air and from leaks in the suction pipe in the brine tank. For the latter reason, the pressure of the brine in the tank (if closed) should never exceed the pressure of the ammonia, which should never be less than twenty pounds per

square inch, absolute, either for economy or leakage prevention.

Ammonia drums should be carried on deck, and permanent connections run from them to the machine, except where joint is broken at the drum. They should be shaded or covered from the sun and weather. The practice of keeping them in the engine room is dangerous and unscientific. The energy of a drum of liquid ammonia compares with that of gunpowder, and at 165 degrees Fahrenheit, it is at a pressure of 550 pounds per square inch. Hence all fittings and piping for the refrigerating machine should be tested at 800 or 1,000 pounds hydraulic pressure. This applies particularly to the condenser, as cases are on record (as mentioned in the last issue) where hot water has accidentally been turned into the condenser, raising the ammonia to alarming pressures for light fittings.

As for the expansion valves, the best are none too good. The automatic type of the best make is to be preferred. The closer they can be adjusted the better, as this is important in small plants; a slight change of the valve throwing the whole system out of regulation for an hour or more, until a balance is again reached.

The piping of the compressor should be so arranged that it can reverse its action and force its ammonia into the brine tank coils in case of leakage, or the necessity of repairs to the high pressure side of the system. This is very important, but is left off of many cheaper machines.

As to the men who have these plants in charge, the safety of the ship, as well as their economical operation and maintenance, requires that they should at least know what anhydrous ammonia is, and also something about the other low evaporative fluids used for refrigerating purposes. They should know every detail of the plant, and its functions. They should know about "wet compression," "dry compression," the heating of compressor cylinders, isothermal and adiabatic compression, why frost on pipes lowers their efficiency, what temperatures are best for certain provisions, and how to get clear ice from dirty water. The refrigerating plant would then no longer be an object of mystery to the owner and chief engineer alike. In the next article we shall treat of the design and operation of the ice house on shipboard.

Oil Steamers.—The lake built steamers *Northwestern, Northeastern, Northland* and *Northtown* are being converted into oil carriers for the Texas trade by the Morse Iron Works, Brooklyn, New York.

Oil Soaked Coal.—The Missouri, Kansas and Texas railroad has been conducting a series of experiments in the use of oil mixed with coal for fuel in its locomotives, and, according to the statement of officials, the new method has proved highly satisfactory, and plans are now being perfected for its general adoption throughout the whole system. The mixing is done by placing the coal in a large tank and thoroughly soaking it with Beaumont fuel oil, thus greatly increasing the steaming power of the coal. By using oil in this form no changes are required in the fire boxes of the boilers.

MODERN SEARCH LIGHT PRACTICE.

BY FRANK C. PERKINS.

Search lights used in the Navy Department of the United States government are fitted with parabolic ground glass silver plated mirrors, except the smaller sizes of 9 inches and 13 inches in diameter, which are supplied with Mangin spherical ground glass silver plated mirrors. While the quality of the light is not so white in the latter, they are not as expensive as the parabolic type, and are used extensively in most commercial projectors. The general design of the American search light as constructed in sizes from 9 to 36 inches by the General Electric Company is noted in Fig. 1. The hand control type is constructed in sizes up to 36 inches, and is arranged so that the beam of light can be trained vertically or horizontally by the operator stand-

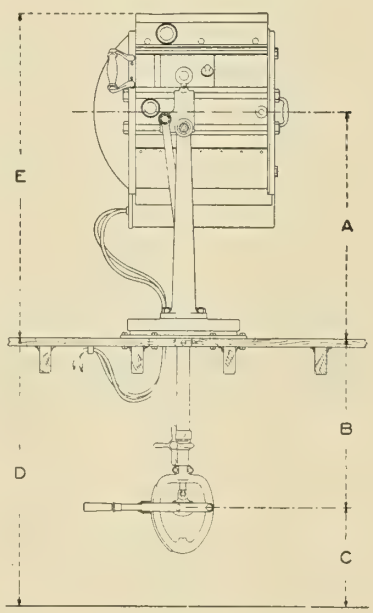


FIG. 1.—AMERICAN TYPE OF SEARCH LIGHT.

ing at the projector and moving the barrel in the desired direction with the handles.

A star wheel is mounted on the arm and clamps the quadrant part of the trunnion and acts as a locking device by means of which the barrel of the projector may be held at any desired angle. The General Electric pilot house control search lights are mounted on the top of the pilot house and operated from within. By the use of a single lever, which is located within easy reach of the pilot the light may be moved in either a vertical or horizontal direction.

The electrically operated search lights of this company are only made in the larger sizes having diameters of 2 feet, 2 feet 6 inches, 3 feet or larger. These search lights are controlled by a single switch or controller handle, which starts or stops the electric motors, operating the horizontal and vertical movements, according as the lever is moved to the right or left or up or down. This is quite an advantage, as the single lever simplifies the control and requires only one hand for the manipulation, while it will be noted that the controller

for electrically operating the Schuckert search light seen in Fig. 7, requires two handles, one for raising or lowering the beam of light and the other handle for moving the beam from right to left or the reverse. In the General Electric electrically controlled projectors, on releasing the handle it is brought back by a strong spring to the neutral position short circuiting the armatures of the motors and holding the projector locked in position. The motors in the base of the projector are connected to the controller by a seven conductor cable, and while one motor operates a train of gears controlling the vertical movement, the other motor operates another train of gears controlling the horizontal movement.

Schuckert designed and built machinery for grinding parabolic mirrors, as suggested by Munker, and these search lights have been adopted in several armies and navies, even in France, where otherwise Mangin's spherical mirrors manufactured by Sautter, Harle and Company, hold the field. The French search light is noted in Fig. 2, located in the fighting top of one of their modern war ships. The diagram of Fig. 4 shows some details of the electrically controlled search light of Siemens and Halske, of Berlin, while Fig. 3 shows a type of English projectors as manufactured by J. H. Holmes and Company, of Newcastle on Tyne.

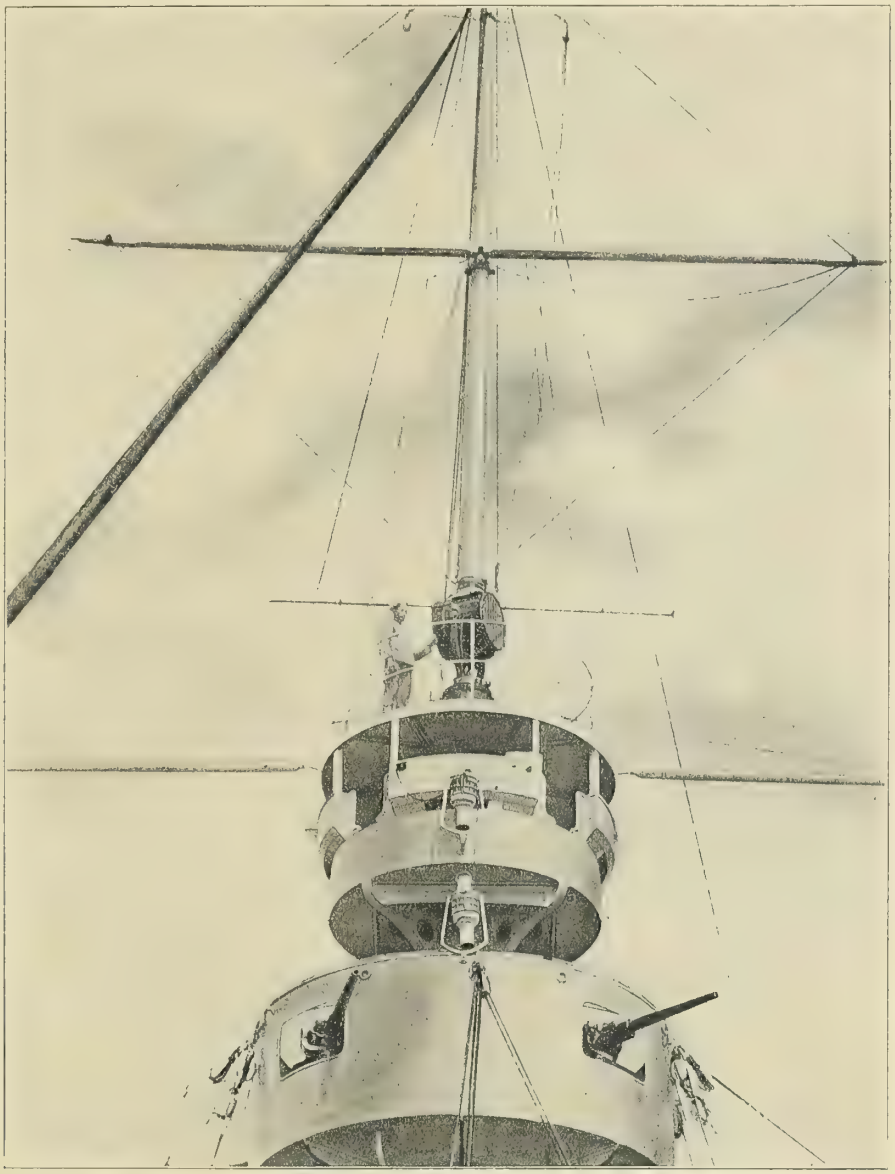


FIG. 2.—A FIGHTING TOP WITH SEARCH LIGHT.

The Mangin type of projector mirror has two spherical surfaces of different radii, and the reflection and refraction of the glass cause the rays of light to be projected in a parallel beam when the arc is in focus. The parabolic reflectors, however, produce a beam of light which is more penetrating, and the Schuckert projectors built at Nurnberg, Germany, have become very popular. In this form the mirror is supported in a

cradle in which it can be turned about its horizontal axis, while the cradle is fixed on a pivoted bedplate, as noted in Figs. 5-7.

In fortifications and on shipboard it is desirable to have two types of search lights, one for illuminating a wide belt for a short or moderate distance and the other for long range work for the intense illumination of an object such as a ship, torpedo or buoy. For the latter purpose the projector is placed high up in the fighting top or in as elevated position as possible, while for the former purpose, using a wide angle of light, it is placed near the water line, as in detecting and following up torpedoes. It is not convenient to have long and short range search lights combined in one, and when projectors are required to furnish a beam of light covering

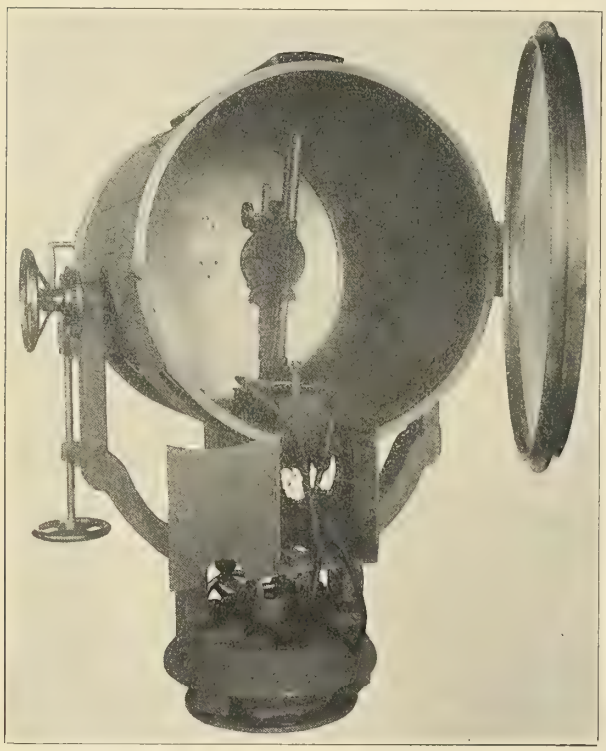


FIG. 3.—AUTOMATIC FEED SEARCH LIGHT.

a wide area, the General Electric Company furnishes a front door made up of strips of glass ground plano-convex, each strip being a lens, with the convex side outward. The beam of light passing through this door is diverged, making it wider but not increasing its height. These diverging doors for either 10, 20 or 40 degrees divergence are furnished for any projector.

Schuckert and Company provide single or double dispersers, the latter consisting of two systems of cylindrical lenses, whose distance apart can be adjusted, and the light thus concentrated in a parallel beam or dispersed to form a cone of 45 degrees. The single dispersers serve to spread the beam in one direction only (usually the horizontal), and consist of a series of plano-convex cylindrical lenses, set in a round frame, and supplied for angles of dispersion of 6, 12, 15, 20, 30 or 45 degrees. The double dispersers consist of two single dispersers, so superimposed that by bringing them together or separating them, either concentrated light of about 5 degrees, or any degree of dispersion up to 45 degrees can be obtained. In the dark spaces thus produced, shutters and signaling apparatus are arranged.

For marine purposes it is often necessary to be able to instantly shut off the light of a projector without interrupting the burning of the lamp. For this purpose

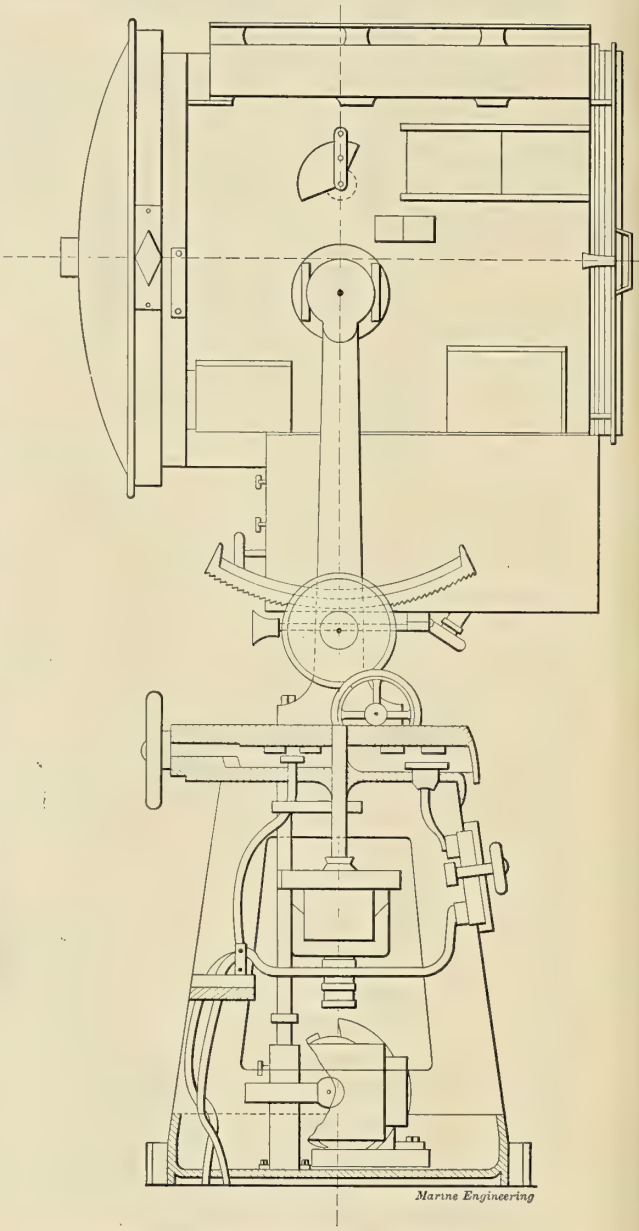


FIG. 4.—SEARCH LIGHT WITH MOTOR CONTROL.

the Schuckert projectors are provided with a special form of iris shutter, often used in photography, which, while easily controlled, possesses resistance against heat and is absolutely light proof. This type of shutter is noted, half closed, in Fig. 7, showing the enormous search light, 2,000 mm. in diameter and having 316 million candle power. This iris shutter is particularly well adapted for use with signaling apparatus. As the central part of the projector mirror (in consequence of the shadow of the negative carbon) does not give out

any effective light, the iris shutter, in spite of the center disk, in no way causes a loss of light. These projectors are sometimes supplied with horizontal automatic arc lamps with shunt winding and with simple arcing device and often with horizontal arc lamps, shunt wound with differential arcing device. These lamps burn two in series and adapt themselves for low primary potentials of 65 volts, and high currents of from 90 to 150 amperes, better than the lamps with simple arcing device.

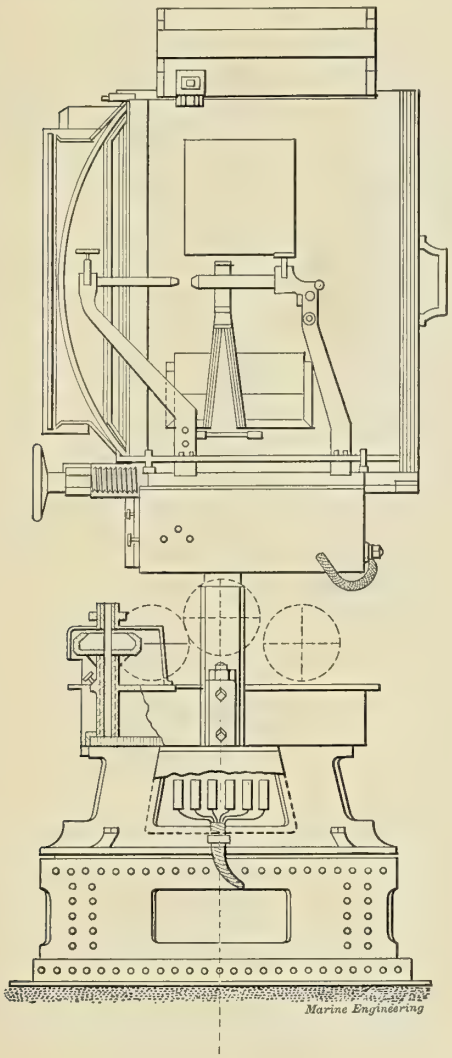


FIG. 5.—SEARCH LIGHT USED ON AUSTRIAN WARSHIPS.

The Schuckert search light projector for land and marine fortresses is seen in Fig. 6. It is fitted with a parabolic ground glass mirror 1,500 millimeters in diameter and has a total power of 180 million candle power. It is arranged for electric motor control, two shunt wound motors being used of the inclosed type. The motors have ball bearings and carbon brushes and are designed for reversible working, with worm gearing and transmission device for turntable.

When the single switch lever is used, it permits each movement to be effected separately, and is provided with armature short circuit brake. The double switch lever arrangement is for both horizontal and vertical directions of movement, and allows both movements to be effected simultaneously. Both levers are provided with armature short circuit brakes to stop the motors suddenly. This device is seen in Fig. 7 connected to motors of the projector by cables, which may be of any reasonable length.

Search lights for military, naval and mercantile marine use are designed differently and with special reference to the work they are to do and the nature of their location. The torpedo boat search light usually has a parabolic glass mirror of from 350 mm. to 400 mm. in diameter, and weighs from 80 to 120 kilograms. It has sometimes hand regulated and sometimes automatic horizontal arc lamps, usually operating at from 30 to 50

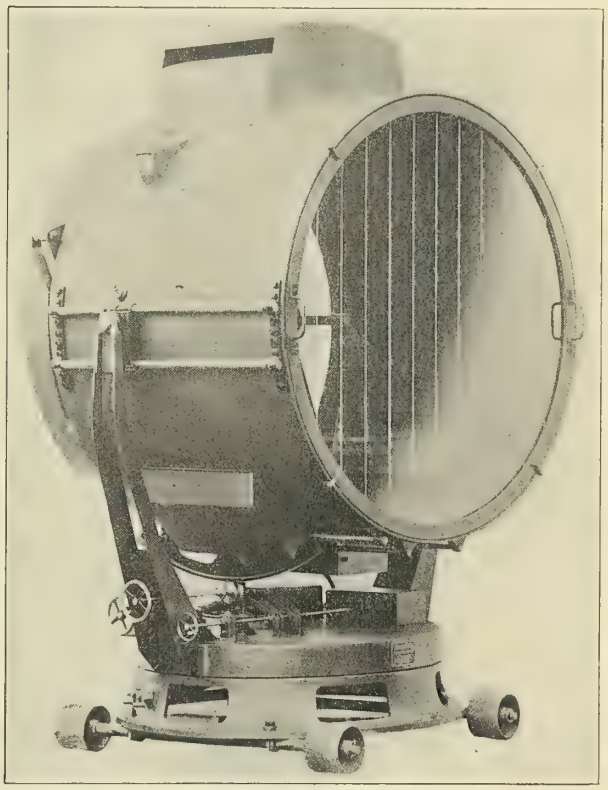


FIG. 6.—180 MILLION CANDLE POWER SEARCH LIGHT.

amperes. Bronze frames and cases are frequently made use of, while for military purposes, aluminum frame and case construction is the rule abroad, with parabolic glass mirrors of 350 mm. in diameter and aluminum automatic lamps using a current of about 22 amperes. This entire outfit only weighs 18 kilograms.

Projectors for naval transport steamers, and for trade and cargo vessels, are usually mounted on high sheet metal pedestals, with parabolic and often Mangin glass mirrors 450 mm. in diameter, with often hand feed and sometimes automatic horizontal arc lamps of current capacity from 40 to 50 amperes and weighing from 170 to 195 kilograms.

The largest search lights are used for naval and large mercantile ships, and have parabolic glass mirrors 600, 750, 900 mm. and even 1,100, 1,500 and 2,000 mm. in diameter, as noted in Figs. 6 and 7. These large pro-

jectors are usually electrically operated by motors and are equipped with dispersers, and iris or other types of shutters according to the country in which they are manufactured. The currents vary for the horizontal arc lamps from 60 to 200 amperes, and the weights from 490 kilograms to 990 kilograms, and even much greater in the 1,500 mm. and 2,000 mm. search lights of Schuckert and Company, ranging from 180 million to 316 million candle power.

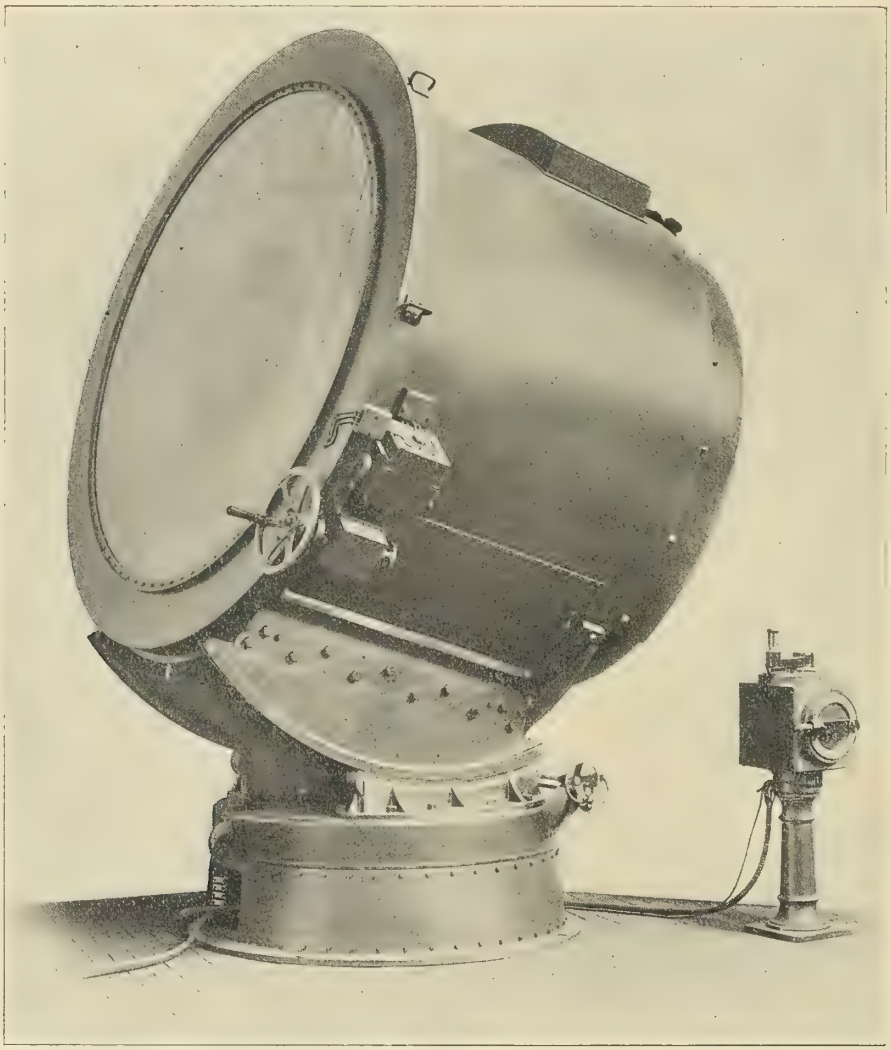


FIG 7.—316 MILLION CANDLE POWER SEARCH LIGHT.

Turbine Driven Torpedo Boat.—The British Admiralty have ordered the construction of another turbine driven torpedo boat destroyer.

Monthly Shipbuilding Returns.—The Bureau of Navigation reports 115 vessels of 79,753 gross tons built in the United States and officially numbered during the month of April, 1902. The largest steel steam vessels included are: *Shawmut,* 9,606; *Alaskan,* 8,671; *Minnewaska,* 5,273; *City of Memphis,* 5,252; *Etruria,* 4,744; *Bransford,* 4,744; *Stel King,* 4,308; *William Nottingham,* 4,234. The foregoing figures do not include craft without motive power of their own.

BEAM ENGINE VALVE GEARS.

BY THEODORE LUCAS.

The large amount of literature that in text books and current publications deals with the important subject of marine valve gears and their steam distribution, is devoted almost exclusively to the form of the common slide or piston valve, and its forms of radial or link reversing mechanisms. It may not be untimely, however, to pay a well-deserved tribute of recognition to the designers and constructors of the distinctively American beam engine and point out the remarkable accuracy and perfection of its steam distribution by a form of valve gear, which, although apparently cumbersome, is remarkably free from possibilities of derangement and affords the greatest possible adaptation to the purpose.

The beam engine has been retained in American marine practice in a form closely resembling Watt's original steam engine construction.

Under our American conditions of a nearly complete absence of over-sea steam shipping, there was no in-

centive to discard the beam engine for service in sheltered waters, as ships with high deck erections can conveniently accommodate the necessary engine shaft. It was the high perfection of the steam distribution by its valve gear that enabled the beam engine to attain, even with low pressure, remarkable economy of coal consumption, which advantage, coupled with few breakdowns and small repairs, made it for a long time an economic success.

The general arrangement in Fig. 1 shows clearly the separate steam and exhaust valves for top as well as bottom ports with their lifting rods and operating cams. Through this complete separation of the valves, it is possible to operate the two separate halves of the rockshafts by the end rockarms from eccentrics that may differ in their angular advance, with the consequent important modification of the steam distribution.

Additional variation may occur in the steam and

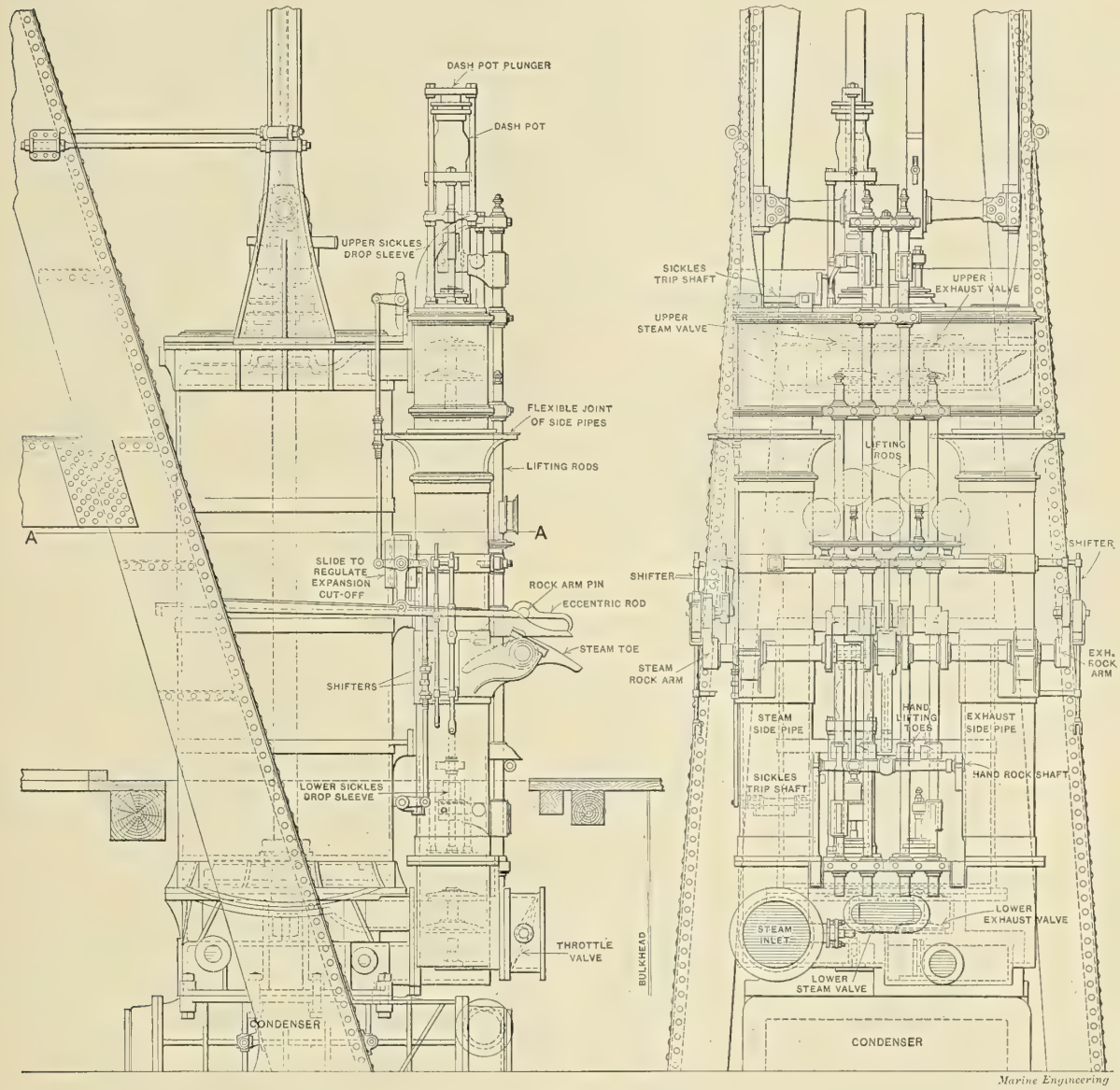


FIG. 1.—SIDE AND FRONT ELEVATION OF A BEAM ENGINE.

The modern poppet-valve gear shares with another production of American engineering genius, the Corliss engine, a number of features that make their functions of remarkable accuracy and precision. The distinctive feature is the introduction of separate steam and exhaust valves. It is thus possible to avoid the compromise, as required for slide valve engines, and to bring out the needs of every period in the steam distribution in full prominence and within wide limits.

exhaust lifting cams in their length, shape and position on the rockshaft, which position determines how much of their swing is actually working stroke. It may prove interesting to show the great variation that can be realized in the indicator diagram by the modification of the different factors. Through the intermittent action of the cams and through the light weight of the valves, a comparatively large stroke and rapidity of opening and closing can be secured, which shows very

favorably in actual cards by an almost entire absence of wire drawing.

The diagrams shown are of a simple elliptical pattern, giving readily a complete insight into the steam distribution, although the ellipse is somewhat distorted by the intermittent action of the gear. The diagrams are developed by representing the piston revolution vertically at 24 equal divisions of the crank circle, while the swing and lifting action of one steam toe and of the corresponding exhaust toe, indicate horizontally the position of the valve that corresponds to these crank and piston positions. Below the toes is given the arc of the rocker arm, which effects their swing, numbered according to the angular advance of the eccentrics. Fig. 2, 3 and 4 show that numerous combinations may be made. As determination of beamengine steam distribution by diagrams is of somewhat rare occurrence, a little difficulty was experienced as to how all the important factors might be represented in a simple form. The diagrams, as shown, appeared to offer the best solution, as they present the following items:

1. Angular advance by the number on the arcs of the rocker pin and the toes.
2. The length of the toes.
3. The shape of the toes.
4. The position of the toes on the rockshaft and the arc through which they are actually lifting.

The influence of variation in the angular advance is clearly seen by a comparison of Figs. 2 and 3. As the lead in the valve gear is more or less a constant quantity, determined by the consideration of fully established steam pressure behind the piston at its end position, it follows that variation of the angular advance has to be accompanied by a shifting of the toe on the shaft until the best lead is again established. The steam toe in Fig. 3 had to be turned down one division of 15 degrees, crank angle with consequent decrease of the steam lift, but with the effect of making the cut-off earlier by 2 divisions. A limit to the turning down and increase of the angular advance is set by the decreased opening of the valve up to the point where wire drawing of the steam would commence.

For the exhaust toe Fig. 2 presents a case analogous to negative exhaust lap in a slide valve, which means that the exhaust period extends over more than one full stroke. From Fig. 2 it is seen that the advance exhaust opening and the compression increase or decrease at the same time, due to this excess of exhaust period. Fig. 3 indicates how, by the turning down of the toe, the period is decreased to less than one full stroke with a consequent possibility of a fixed advance exhaust opening and of regulating the compression to a desired degree.

The length of the toes may have an important bearing upon the lift of the valve, as it is evident that a steam toe of double the length swinging through the same arc will raise the valve approximately twice the former distance. The point of practicability is the main one to be considered. The toes should not be too unwieldly and clumsy nor bear at the end of the swing only on a narrow edge. The relation between the length of the toe and that of the rocker arm and the stroke of the eccentric enter also into the consideration, in order to prevent the angels A or B from attaining a value much more than 45 degrees. The influence of the shape of the toes is presented by Fig. 4 as a modification of Fig. 3 by substituting entirely straight toes for curved ones. It is evident that absolutely straight toes would be undesirable for smooth working, as producing shock and wear; but a certain amount of straightening in the toes may sometimes make desired modifications possible in the steam distribution.

The position of the toe on the rockshaft and that part of the arc during which lift of the valve occurs are regulated, as stated, by the consideration of lead and angular advance, with due consideration for the prevention of wire drawing the steam.

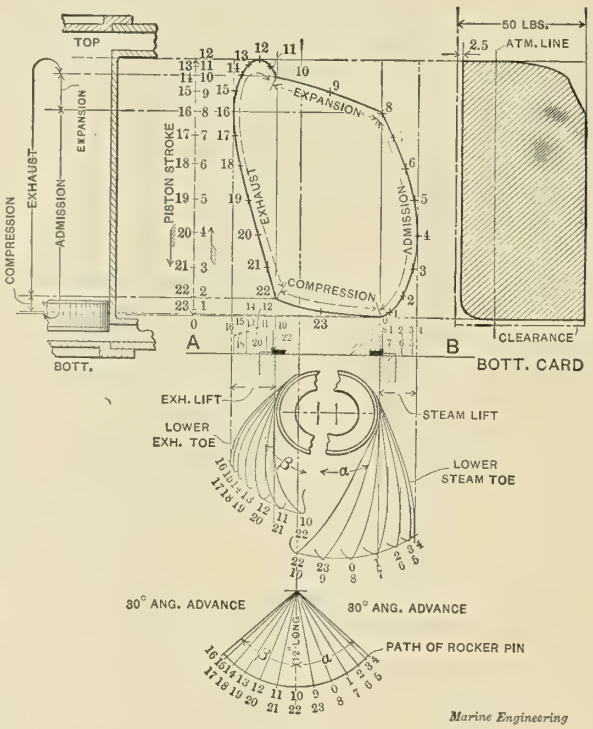


FIG. 2.—VALVE DIAGRAM.

Especially in the older beam engine, permanent provision was occasionally made for turning the toes up or down, as deemed best by the operating engineer. In some cases the exhaust toes were rotated on the main rockshaft by small eccentrics on a slide shaft, but this arrangement has been abandoned as too complicated and less secure than keying in the desired position.

The conditions of beam engines with their relatively low piston speed and small clearance spaces make it easy to secure very large openings in the valves, and the cards taken show a remarkable sharpness found nowhere else except in the Corliss engine. Fig. 3 presents a case with a cut-off at about the desirable limit, as further decrease of the cut-off would necessitate either longer or straighter steam toes or smaller valve lifts. This normal arrangement is known by the name of the Stevens cut-off, in honor of a member of the family, whose name is so intimately associated with the development of American marine engineering.

To secure still shorter cut-offs, a special drop cut-off, known as the Sickles gear, is employed. Fig. 5 shows an arrangement as applied to an upper steam valve. The gear is operated by a special cut-off eccentric which by lever transmission forces little slides on the valve stem arms at certain positions, to the extreme end of their paths, thereby releasing the valve and valve stem from the support of the arm and allowing them to drop to the valve seat. To prevent a destructive blow, an overhead dashpot is connected to the valve stem, which retards the motion toward the end of the stroke and helps to seat the valve gently. The disengagement of the valve stem is produced by the partial rotation of a ring through gearing by the stroke of the slide. This ring has a number of inside teeth which correspond to an equal number of outside teeth on a long sleeve secured to the valve stem. By rotation, the ring may bring its teeth under the teeth of the sleeve and, being firmly held by the lifting arm, carry the valve stem and the valve with it.

If, after further rotation, the teeth of the ring are brought under the grooves of the toothed sleeve, and the grooves of the ring under the teeth of the sleeve, the support is lost and the stem and valve drop, causing the sleeve to slide through the ring. After the lifter and its arm have completed their stroke, the ring is rotated back by a spring to its original position, ready for a new lift with the arm.

The release of the valve occurs when the actuating lever pushes against the pin on the slide, carrying the slide with it to the extreme position. If it should be deemed desirable to have the cut-off at division 4, Fig. 3, then the cut-off eccentric, for an arrangement as shown in Fig. 1, would have to be approximately either 120 degrees ahead or 60 degrees behind the crank to obtain the desired result. It is apparent that the shifting lever will pass the pin and slide twice during each revolution of the shaft, but also that only the passing at position 4 of the crank will be productive of results, as at the other position the lifter, arm, valve stem and valve are at rest and the ring will rotate loosely back and forth.

A peculiarity of the beam engine may also be observed in the reversing gear. Link gear, as formed in vertical engines, is entirely unknown. The eccentric rods in beam engines connect to the rock arm pins only by open slots which hook from above over the pin, as seen in Fig. 1. Through the shifters, the ends of the eccentric rods can be raised until free from the pins, thus cutting off the automatic control of the steam distribution. To keep the engine under control, a special rockshaft, with small steam and exhaust toes, is arranged, and by manipulating this through a hand lever, the valves are lifted and the steam is distributed according to the desire of the engineer, for ahead or backing motion. As the strokes per minute are few, this arrangement proves quite effective in the hands of experienced engineers, who, with the help of a dial showing at the platform the exact position of the crank, can time the steam distribution in a satisfactory manner.

Where reversals occur frequently, as in ferry boats, backing eccentrics and eccentric rods for steam as well as exhaust are fitted which are also provided with shift-

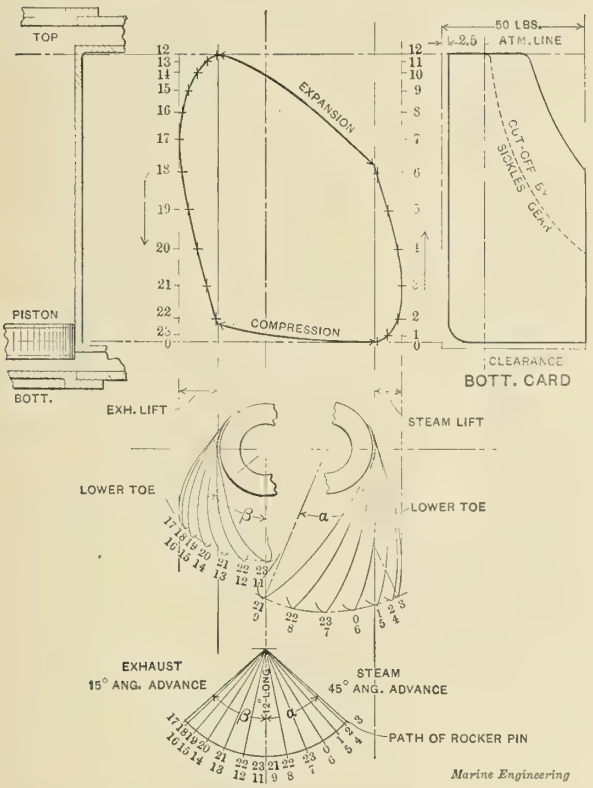


FIG. 3.—VALVE DIAGRAM.

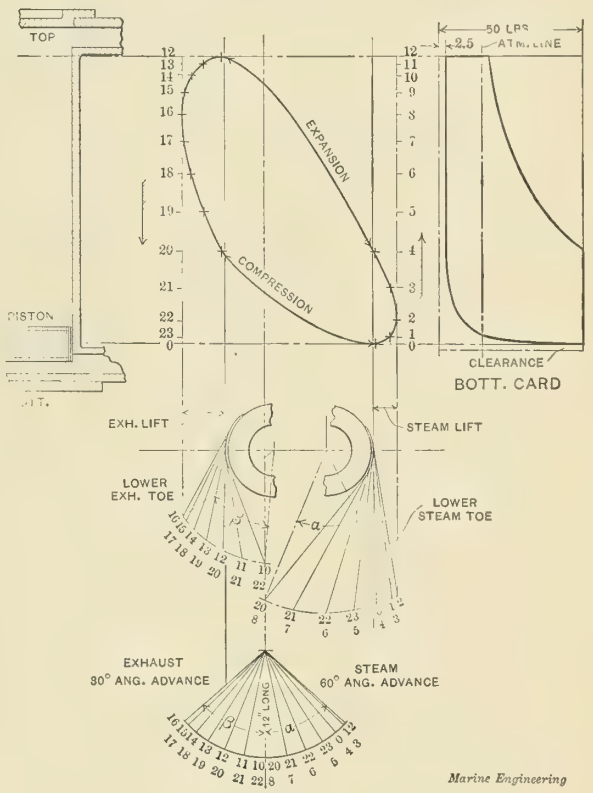


FIG. 4.—VALVE DIAGRAM.

ers and which, upon lowering, hook on to a special extension of the rock arm pin. It is evident that the ahead and backing shifters must be so connected that if one eccentric rod is hooked on, the other one is lifted off.

the very successful engine of the steamer *Bay State*, of the Portland-Boston route, as built by the firm in 1894. From other notes, data and diagrams kindly furnished by this company, the writer was enabled to develop the diagrams as shown.

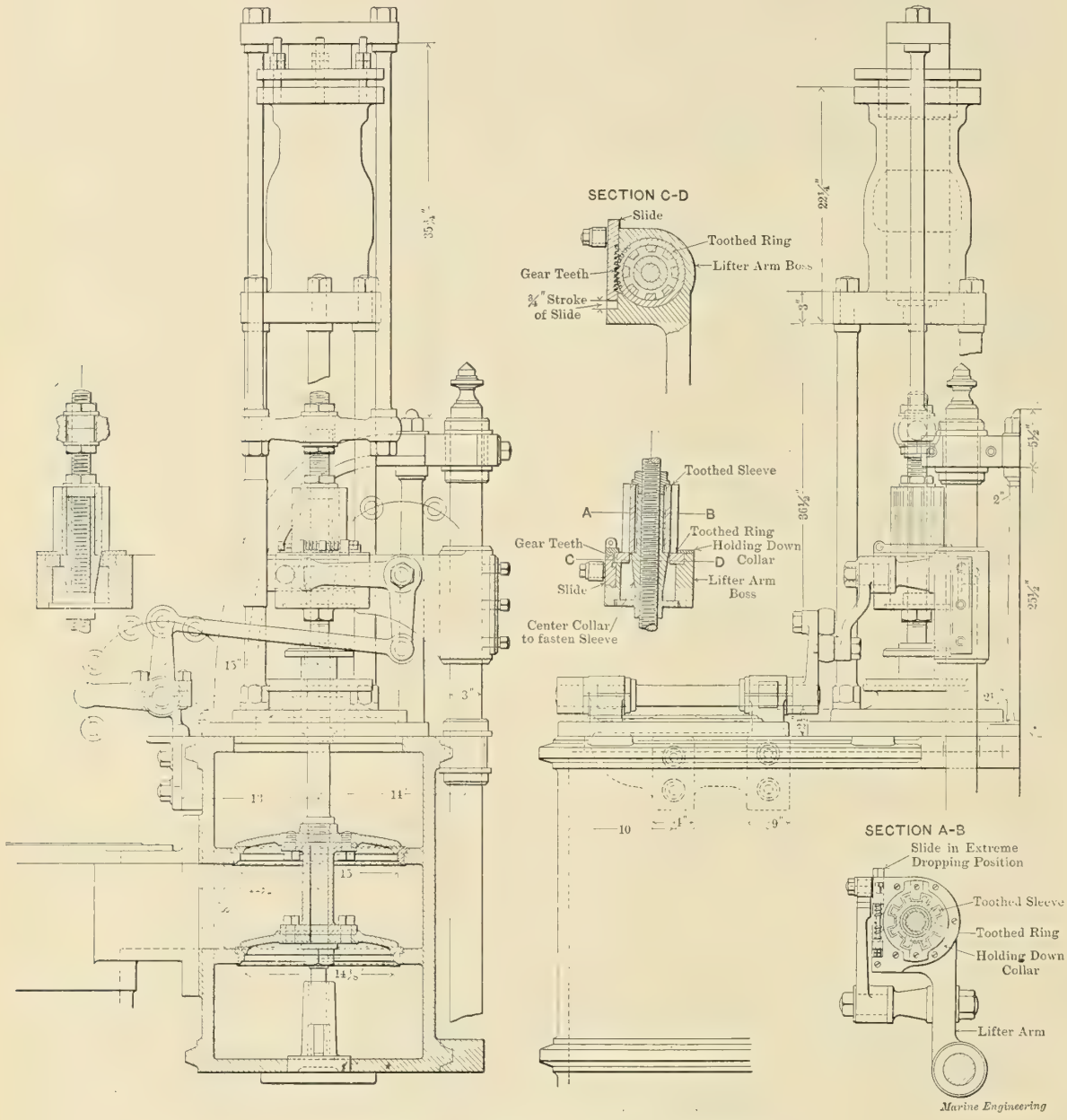


FIG. 5.—DETAIL OF VALVE AND CUT OFF ON A BEAM ENGINE.

The beam engine offers one of the most original developments of marine engineering and has held for a long time an almost unchallenged popularity in river, bay and sound steamers, giving way but slowly under the overwhelming advantage of the higher steam pressure and decreased weight of more modern constructions.

The Figs. 1 and 5 are presented through the courtesy of the Portland Company, Portland, Me., and represent

Huge Lumber Raft.—A raft containing 11,000,000 feet of logs equivalent to three times the dimensions of the ordinary log raft, has recently been floated down the Mississippi. Two river steamers were used for controlling the raft, one, engaged in towing head, while the other was used as a bow boat to swing the big float back and across the shallow steamer to avoid shallow water and difficult places.

ELECTRIC IGNITION.

BY DONALD M. BLISS.

The past few years have witnessed a great development in explosive engines for marine and automobile use. There are a number of designs now on the market which are thoroughly well built, efficient in operation and reasonable in price. It is to be regretted, however, that no perfectly satisfactory system of ignition has yet been found; and there probably is no detail in a gas or gasoline engine so productive of annoyance and delays as the apparatus or method for exploding the charge. As either the jump spark or wiping contact methods are almost universally used, our remarks will not include hot tube or automatic explosive devices.

Gas engine manufacturers have devoted much time and money in search of a satisfactory electric igniter; but as the principles involved belong to the field of electrical engineering rather than engine building, and the conditions governing their satisfactory operation are unusually trying, it is not surprising that so far the efforts of the engine manufacturers have not been crowned with success. In many cases the purchaser of a gasoline launch is carefully educated regarding the special merits of the various engines on the market in general, and the one he selects in particular, but is left in comparative ignorance regarding the most satisfactory arrangement for ignition and the proper care of the battery or dynamo used for the purpose.

There are, broadly speaking, two methods of generating current: the battery system and dynamos. The former includes primary batteries as well as storage batteries, and the latter may also be divided into two classes, including the dynamo and magneto generator. The character of the current produced by any of these should be alike as to volume or quantity and pressure or voltage, and in all cases direct current should be used, and not alternating. The use of a magneto generator similar to that used for telephone service has been frequently proposed and tried. This form of generator, as is well known, delivers a current alternating in character, and there are, therefore, two positions in the revolution of its armature when the pressure is zero and no current generated. It is impossible to overcome this effect in the alternating current generator, and, therefore, when the engine is in operation, the sparking contacts may be operated just at the instant the generator is not producing a current, and there will be consequent failure to explode.

Regarding the method of ignition the wiping or touch contact arrangement is much to be preferred for marine engines, owing to the ever present moisture and the resulting difficulties in securing the high insulation necessary for proper operation of the jump spark. Batteries of the open circuit form are frequently advised, and used by the inexperienced, but a short trial will convince one that this type of battery is not at all adapted for continuous use. Such a battery, whether of the dry cell or liquid type, weakens very rapidly under the severe conditions imposed, and while the first cost is low, the frequent renewals necessary render their use the most expensive method of generating current. For this purpose batteries of a closed circuit form, such as the Edison Lalande, are quite frequently used, and these, owing to their greater current capacity and low internal resistance, are much more satisfactory. These cells are quite expensive, however, and supplies or renewals not easily obtained on extended trips, and owing to a solution being required, they are liable to accident and breakage.

Storage batteries are sometimes advised, and when properly installed and under careful supervision they give excellent results, both in staying power and quantity of current generated. The use of storage cells, however, involves the necessity of frequent charging, and it is often difficult to find the required current for this purpose when away from headquarters. There is a decided tendency at this time to discard the use of batteries in any form and rely on the igniting generator of either the dynamo or magneto type.

Before considering the respective merits of these two machines it may be well to consider the condition imposed on the generator by the modern wipe or touch contact system.

When the contacts in the cylinder are closed the electric circuit includes only the generator, a spark coil, the contacts, and a few feet of conducting wire. As the resistance of the spark coil is usually very low and that of the wire and contacts almost negligible, it will be seen that the generator at this instant is run almost short circuited, or under an extreme overload. As soon as the contact separates, and the spark is made, this condition is completely reversed; the circuit is open and the load is removed from the generator until the next contact is made. The dynamo is therefore run under a rapidly intermittent load. While the average amount of energy required to produce a satisfactory spark is small, the dynamo must be designed to operate under this intermittent overload without sparking or overheating at the machine itself. The commutator and brushes are without question the weakest parts of these small machines, and it is just here that the owner of a gasoline launch will find the most annoyance. The brushes used on most dynamos are almost invariably too small and the holder and connections flimsy in construction.

It is absolutely necessary that both the commutator and brushes be kept clean and free from dust and oil, and the generators should be so designed that while these parts can be completely enclosed and protected while in operation, the protection can be readily removed so that free access may be had for cleaning and examining brushes and commutator. The kind of brush to be used depends considerably on the style of machine and the voltage or pressure for which it is wound. In general it may be stated that machines delivering from 15 to 25 volts will operate more satisfactorily with a carbon brush, providing the holder is large enough and has satisfactory means for securing a good tension on the brush itself. The writer has found a composite brush made of copper gauze imbedded in carbon most satisfactory for this work. The copper gives the required conductivity and the carbon preserves the commutator, thus securing the sparkless operation so necessary to the life of the machine. If the generator is wound to give a low pressure of 5 to 10 volts, the only reliable brush is one made of leaf copper or copper gauze. The commutator itself should be made of the best hard rolled copper only, and a machine having brass or composition segments should not be accepted. As

these generators are operated frequently at very high speeds, and unfortunately receive very little attention, the shaft bearings and method of lubrication should be perfect. Bearings of the best phosphor bronze, provided with grease cups and suitable feeding device, give the most satisfactory results in the long run.

The above remarks, covering brushes and commutators apply to machines of both the dynamo and magneto type with equal force.

The chief objection to the all copper brush is the destructive effect on the commutator caused by the slight spark, which is characteristic of improperly designed machines operating an intermittent load of this character. The relative merits of magneto and dynamo types of machines are frequently discussed, but there seems to be little uniformity of opinion as to the best type for any given case.

A Salvage Case.—Judge William T. Townsend in the United States District Court recently handed down a decision in which he held at fault steamship *La Bourgogne,* of the French Line, for colliding on April 4, 1898, off Sable Island, with the British ship *Cromartyshire.*

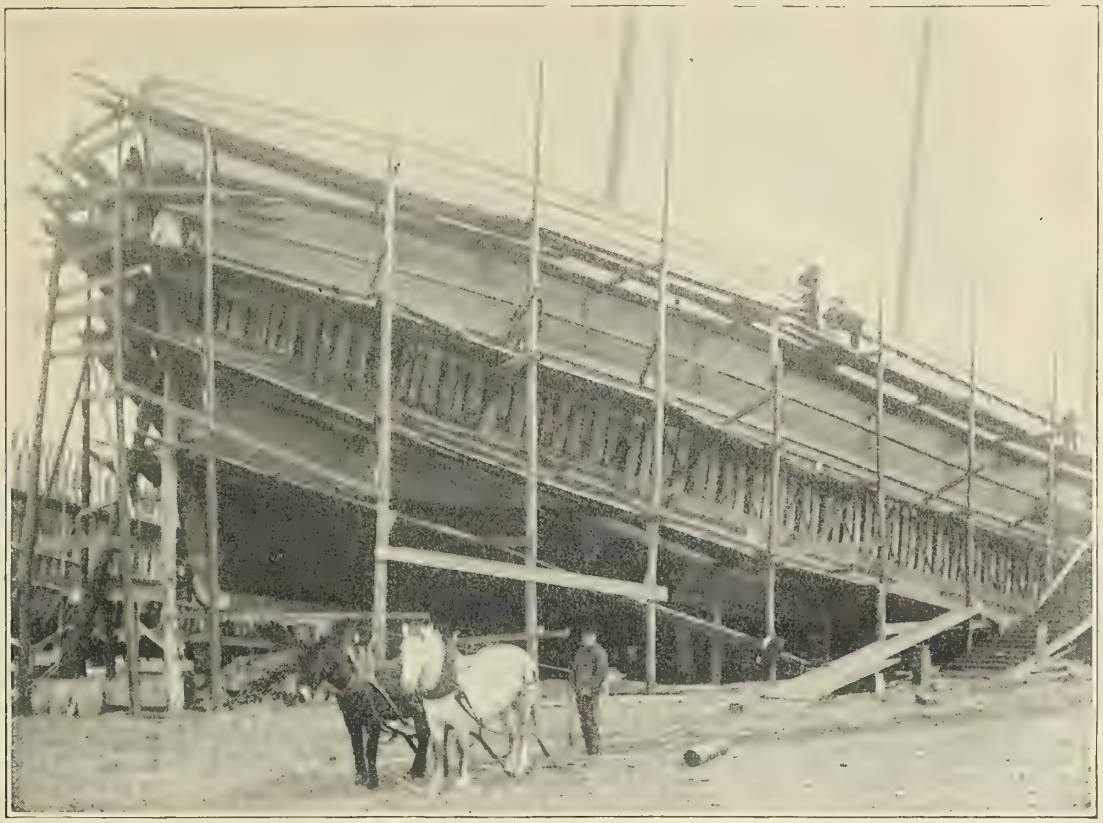
Fleet of Oil Steamers.—It is stated that the steamships owned by the American-Hawaiian Steamship Company are all to be converted into oil burners. The oil will be supplied to the ships at New York, Straits of Magellan and San Francisco. The supply at the Straits will be given the passing steamers from tank steamers stationed there.

Large Wooden Barges.

An important innovation in wooden barge construction is exhibited in the two big barges *Cienfuegos* and *Santiago,* now being built for the Staples Coal Company, Taunton, Mass., at the yard of Kelley, Spear and Company, Bath, Me. This is the strapping of the frames together with diagonal bands of steel. This method of construction has been used heretofore in the building of steamships and the larger schooners, and in fact is required in the classification of wooden vessels of over 1,000 tons burden whose length exceeds ten times their depth, but it has not before been used at any of the yards in this section in the building of barges. The great length of these barges in proportion to their width and depth, and the fact that their bilges are thus unusually wide and flat and that they are intended for long voyages instead of the coastwise service, have induced the owners to adopt this mode of construction, of course at an increased cost.

LARGE WOODEN COAL BARGE BUILT AT BATH, ME.

The dimensions of the *Cienfuegos* and *Santiago* are as follows: Length over all, 280 feet; breadth, 46 feet; depth, 19 feet; carrying capacity, 4,000 tons. They are 40 feet longer, three feet wider, and their carrying capacity is a thousand tons more than barges of the *Matanzas* and *Cardenas* type, which were built at this yard last spring, and were at that time the largest ever constructed here. The method of setting up and fastening the frames of these barges is similar to that employed in the construction of the larger schooners. The frames are of hackmatack and birch and the planking and ceiling of hard pine. An idea of the strength of their construction can be gained from the fact that the



PLANKING THE CIENFUEGOS.

DECK OF WOODEN BARGE CIENFUEGOS, LOOKING FORWARD.

nine keelsons are each 14 by 14 inches. The planking is of 5-inch stock and the ceiling 12 inches.

The method of strapping will perhaps be of interest. The belt strap, which extends around the top of the barge from the stem to the transom, is 8 inches in width by 3-4 inch in thickness. This strap is bolted to every frame, the ends of the bolts being secured on the inside of the frames by countersunk nuts. The diagonal straps extend from the belt strap at the top down to the slant floor at the bottom of the barge, running parallel to each other at a distance of 5 feet, a second series of parallel bands crossing the first at right angles. Where these bands cross the frames they are secured to them in the same manner as are the belt straps, and where they intersect between the frames they are riveted together with hot rivets. They are also riveted to the belt strap at the top. Grooves are cut on the outside of the frames after they are set up so that the straps are sunk below the surface and the planking can be put on smoothly over them. The planking is treenailed to the frames throughout, instead of only up to the water line as is the method of construction adopted at some yards. The butts of the planking are secured by galvanized bolts. It will be noted that this substantial network of steel strapping renders these vessels especially capable of sustaining the great strain that naturally falls on the bilges in a vessel of this length with only a single deck, and obviates all danger of the bilges dropping down.

The *Cienfuegos* and *Santiago* will have four masts and will spread 2,500 yards of canvas, an unusually large amount for a craft of this class. The generous supply of canvas carried by the barge *Cardenas* proved to be especially serviceable when she broke adrift during a recent storm. These barges will be even better equipped in this particular. Their rigging will be of wire throughout.

As these barges are designed especially for the Cuban trade and will carry large unassorted cargoes, their holds are not divided into separate compartments as is the case with the smaller barges designed merely for the coasting trade. They will each have six hatchways, which will greatly facilitate the discharging of cargoes. Each barge will be equipped with a No. 9 steam windlass of the Hyde type, and two hoisting engines, and each will carry two 4,000 pound anchors and 180 fathoms of 2-inch chain.

They have but one house, situated well aft. The wheel room and crew's quarters are located directly over the captain's quarters, which are on deck. These quarters are finished in pine, grained and varnished. The best of material is used and the greatest care maintained throughout the entire construction of these craft to make them perfectly stanch and seaworthy, capable of carrying for long distances their heavy cargoes safely even in the face of heavy gales and high seas.

The barges will each carry eight men besides the captain. The *Cienfuegos* was launched ready for sea the last of March, while the *Santiago* is soon to go overboard.

SCHOONER WRECKED BY COLLISION AT ST. JOHNS, N. B.
(Photo. by Conton, St. Johns, N. B.)

Collision at St. Johns, N. B.

The packet schooner *Princess Louise* was run down and wrecked February 12th by the steamer *Prince Rupert* during a heavy fog. The little vessel was anchored in the harbor at St. Johns, having come in from Grand Harbor, Grand Manan. She anchored directly in the path of outgoing steamers, and was

shortly after run down by the *Prince Rupert*. The schooner, as is clearly shown, was a total wreck, the sharp bow of the *Rupert* having struck squarely on the stern of the schooner, cutting through from deck to keel. The port bow was not damaged, while the starboard bow was dug out from the stem to the bulkhead. The schooner was towed at high water on to the shore and beached, as seen in the illustration.

Explosion of Boiler.

Shortly after one o'clock on the night of February 5th, the boiler of the Pittsburg Harbor towboat, *John W. Ailes*, exploded, killing one man and fatally injuring another. The towboat was going down the stream with its loaded barges, and when opposite the Edgar Thompson Steel Works at Braddock the accident occurred, and in a very short time the boat was burned to the water's edge. The accompanying illustration is of the wreck of this towboat, and shows barges on either side which were used in raising the wrecked vessel. The *Ailes* was a comparatively new boat, belonging to the Monongahela River Consolidated Coal and Coke Company, and was used for towing coal barges about Pittsburg. She was 135 feet long, 25 feet beam and 4 1-2 feet deep.

PITTSBURG TOWBOAT JOHN W. AILES, WRECKED BY BOILER EXPLOSION
(Photo. by Chautauqua Photographic Co., Pittsburg, Pa.)

CARE AND MANAGEMENT OF THE MARINE GASOLINE ENGINE—I.

BY E. W. ROBERTS.

Gasoline engines were first employed as a motive power for boats the latter part of the eighties. Since then they have gradually increased in popularity until now boats driven by gasoline engines are to be found in nearly every quarter of the globe. While their principal use is for pleasure craft, quite a number are employed for business boats, such as oyster dredges, tugs, small excursion boats, and even in the life saving service. It is the intention of the writer, in the present series of articles, to give the reader some practical hints in regard to the care and management of these engines, point out the troubles that are most likely to occur and the remedies which apply in each case. As it is necessary in the care of any machine to understand the principles upon which it operates, the writer will, for the benefit of the uninitiated, describe as briefly as possible what takes place in the gas engine.

TWO TYPES.

Two types of gas engines are in use for marine purposes, the four-cycle engine, in which the piston receives an impulse in each cylinder once in two revolutions of the crankshaft, and the two-cycle engine in which each piston receives an impulse at every revolu-

tion of the crankshaft. The latter has had its widest use for boat propulsion, and has been used but little for stationary purposes. The four-cycle engine, which has practically held the monopoly in the stationary field, is gradually being adopted by marine engine builders, especially for the larger powers. In the following explanation the engine will be considered as of the vertical type, since this is the only type commonly employed for marine purposes.

FOUR-CYCLE TYPE.

In the four-cycle engine four strokes of the piston are required to complete the series of operations necessary to produce one impulse. In the first stroke of the cycle the piston is traveling downward, and a valve is opened which communicates with the atmosphere and the gasoline supply, drawing into the cylinder an explosive mixture of gasoline vapor and air. On the following upstroke of the piston, the inlet valve is closed and the charge of fuel and air is confined within the cylinder, being compressed into the space between the end of the piston and the cylinder head, called the compression space or clearance. Just before the piston reaches the end of this stroke, the charge is ignited by an electric spark or other means, the ensuing rapid rise of pressure or explosion reaching a point from four to four and one-half times the pressure of compression. The piston then starts on its next downward stroke, expanding the burned gases and giving an impulse to the piston. Just before the expansion stroke is completed and about one-tenth of the stroke from the end, the exhaust valve opens, the burned gases are free to escape to the atmosphere, and the next upstroke of the piston expels them almost entirely from the cylinder. The exhaust valve closes just at the end of this stroke and the inlet valve opens, a new charge is drawn in and the cycle is repeated.

TWO-CYCLE TYPE.

In the two-cycle engine, practically the same course of events is passed through with, however the elimination of the exhaust stroke and the suction stroke of the four-cycle engine. In this type of engine the crank is entirely inclosed, so that on the up stroke of the piston a vacuum is produced in the crankcase into which the charge is drawn as in the suction stroke of the four-cycle engine. On the down stroke of the piston the charge is compressed to from two to six lbs. per square inch, and just before the piston reaches the bottom of the stroke it uncovers a port leading to the crankcase, the charge rushes upward into the cylinder of the engine striking a projection on the piston, which deflects it to the top of the cylinder. On the following up stroke of the piston this charge is compressed into the clearance space, and at the same time a fresh charge is being drawn into the crankcase. Ignition and expansion follow, and just before the inlet port from the crankcase is opened the piston uncovers an exhaust port on the opposite side of the cylinder, through which the exhaust escapes to the atmosphere while the incoming fresh charge assists in clearing the cylinder of the burned gases.

To the reader who is unable to understand the principles of the gas engine from the above description, the writer would suggest that he secure a textbook on this subject, of which there are several in print. He is advised to familiarize himself thoroughly with the above, as it will many times assist him in locating the causes of trouble where otherwise he would be most likely to stumble along in the dark, resorting to guesswork, which is always slow and quite often futile.

EFFICIENT WORKING.

In the engine proper, aside from its accessories, there are several points bearing upon efficient working that it would be well to bear in mind. In the first place the charge of gasoline and air should have the fuel in proper proportion to the air. If there is too little gasoline the impulse will be weak, and sometimes no ignition will take place, while frequently in a two-cycle engine a mixture poor in fuel will often take fire in the crankcase, retarding the piston and slowing the engine. If there is too much gasoline the engine will act sluggishly, and usually much of the gasoline will pass out of the exhaust unconsumed. This may quite frequently be detected by the engine acting as if it were tired, being sluggish and apparently having a drag upon it. Again, if the operator's face is held near the exhaust the unconsumed vapor will produce a sharp pain in his eyes, as well as giving forth an intensely strong odor of gasoline.

The opening of the inlet pipes and the valve should be sufficiently large to allow the charge to be drawn in without the pressure in the cylinder falling more than a pound or two below that of the atmosphere. The forming of an excessive vacuum during the suction stroke, called wire drawing, is to be avoided, as it prevents the engine from getting a full charge and results in a consequent loss of power.

The piston of the engine should be tight in order to bring the compression up to the required point, which is between 75 and 85 pounds for a gasoline engine, the latter pressure being practically the limit for gasoline. As the maximum pressure is in direct proportion to the compression pressure, any falling off in the compression will result in a lower maximum pressure, and the expanding charge will give a consequently less powerful impulse to the piston, resulting in a falling off of power.

POINT OF IGNITION.

Another item of importance is that ignition should take place at the proper time in the compression stroke. There is a definite time required after the spark takes place until the mixture is entirely in flame and a maximum pressure attained. It is generally conceded by experts that the maximum pressure should occur as nearly as possible at the beginning of the expansion stroke to get the most powerful impulse. This is quite an important feature in the operation of the gas engine, since, if ignition is too early, it will cause maximum pressure to occur before the end of the stroke, retarding the piston and lowering the power. Again, if the spark occurs too late, the average pressure to the piston is decreased with the same result as with too early ignition. Premature ignitions quite often result in stopping the engine entirely, but a tardy ignition usually results simply in decreasing the power.

With the same fuel mixture, meaning both the quality of the fuel and its proportion to the air, and under like conditions of compression pressure and temperature, the period of inflammation is precisely the same no matter what the speed of the piston. By the period of inflammation is meant the time from the moment the spark

occurs until the flame has reached every part of the charge. It will thus be seen that as the speed of the engine increases it is necessary to advance the point in the stroke at which the spark occurs in order to get complete inflammation and maximum pressure at the beginning of the expansion stroke. If the ignition is too early it will often make it difficult to start the engine, throwing the piston back and occasionally throwing the engine in the wrong direction. It is generally desirable to use a device for changing the lead of the spark, advancing it as the speed increases, in order that the engine may secure the greatest possible impulse at any speed. When the ignition occurs before the end of the compression stroke the igniter is said to have positive lead, usually called simply lead; and when the spark occurs after the beginning of the expansion stroke the igniter is said to have negative lead. A variable lead igniter is one in which the time of ignition may be changed either by an automatic device or by the hand of the operator.

On the smaller engines the lead is usually made constant, and hence a quick turn of the flywheel is required in starting them, or else the engine would start backwards. In these engines it is usually the custom to make the lead a compromise between that required for the engine running at normal speed and no lead at all. This is done in order that the engine may be started easily and also that it may have very nearly its full power when running at normal speed. An igniter with too much lead will cause excessive racing when the engine has no load, and when the load is applied it will not respond promptly to the throttle, as, when the throttle is opened wide, it will be very slow in reaching its normal speed. Premature ignitions are usually indicated by a thumping in the engine, although this may be produced by several other causes, which will be discussed later.

EXHAUST.

The exhaust valve should open sufficiently early in the stroke to allow the pressure in the cylinder to reach that of the atmosphere by the time the exhaust stroke is completed. For engines running at or near a piston speed of 600 feet per minute the valve is opened when about 90 per cent. of the stroke is completed. As the speed increases the exhaust valve should open earlier, and as the speed of the engine is decreased it should open later in order to get the least back pressure and yet not lose any of the thrust due to relieving the pressure too early. The exhaust passages, including the muffler, should be reasonably free from resistance to the gases, otherwise there will be back pressure retarding their escape and also a back pressure on the cylinder retarding the piston.

Of course the best way to discover what is going on inside of a gas engine cylinder is to take an indicator card and study the diagram; but as this is usually out of the question for the operator, the best way is to watch the engine and see that the valves are in proper time by noting their position when the engine seems to give the best results. The inlet valve should open just at the beginning, and close at the end or immediately after the end of the suction stroke. The exhaust valve should invariably close just as the exhaust stroke is completed. Both valves should be tight at all times, and if they should leak they should be reground to their seats with pumice stone and oil, but at no time should emery be used. In case pumice stone is difficult to obtain, the dust from a grindstone will be found a satisfactory substitute.

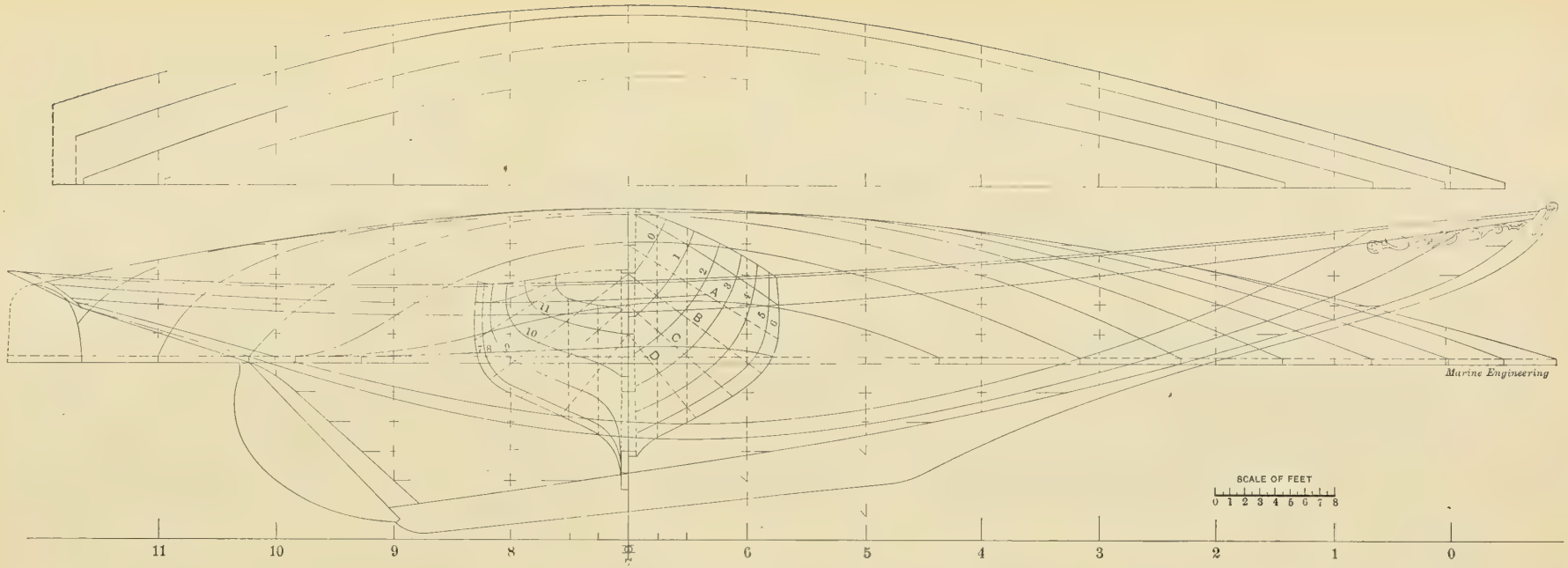
THE KNOCKABOUT FISHERMEN.

The Gloucester fishermen have from time past always been on the lookout for some improvement on the model or construction of their craft which would make them better as regards speed, seaworthiness, or comfort. Hemp standing rigging, stone ballast, and the old fashion model have gradually given place to steel rigging, iron ballast, and the most up-to-date model, until the Gloucester schooners of to-day have the appearance of a yacht more than of a schooner which has to be able to ride out gales on the banks that send all but the largest ocean steamers to port for shelter.

The fishermen have for a long time kept their eye on the new style of yacht called the knockabout, and one or two half successful imitations have been built, but at last Capt. Wm. Thomas decided that he would try a knockabout fisherman pure and simple, and commissioned Capt. Thomas McManus, from whose drawings have been built a number of successful up-to-date craft, to get out the lines for a fisherman which was to have no bowsprit, the overhang forward being carried out in excess to take its place. This he hoped would not only give the craft greater speed on account of making longer and easier lines, but it would overcome the danger of the sailors going out on the bowsprit to furl the jibs, which in a gale of wind, especially in the winter time when everything is slippery with ice, is a very dangerous undertaking.

The new craft, the *Helen B. Thomas*, whose lines and sail plan are published herewith, is the first craft to successfully carry out the knockabout idea. Her success can thus far be judged only from her trial trip, which occurred recently in a very heavy breeze, so heavy that at times she had all she wanted with a single reefed mainsail and two jibs. Even under these conditions, which were such as few new crafts would have picked for a trial trip, she behaved admirably, showing that while she held most of the good qualities of the knockabout she had entirely done away with that bad quality, excessive pounding; for although the sea was very steep and she threw considerable water, there was no shock as she struck the waves, and she did not lose her headway, but kept right on without seeming to mind the sea in the least.

As regards the speed there were one or two larger schooners that started from Gloucester at about the same time as the new craft, and although it was a dead beat all the way there, she showed her heels to them all, and when she ran into Boston harbor, the nearest was fully two or three miles astern. On the way it was noticed that she obeyed her wheel very quickly, and it was decided to try and see how quick she could tack. It need hardly be mentioned that designer, owner, crew and guests were very much surprised when it was found that she tacked from full to full under those unfavorable conditions in 23 seconds. After getting way on it was tried a number of times again, which showed that



LINES OF KNOCKABOUT FISHERMAN HELEN B. THOMAS.

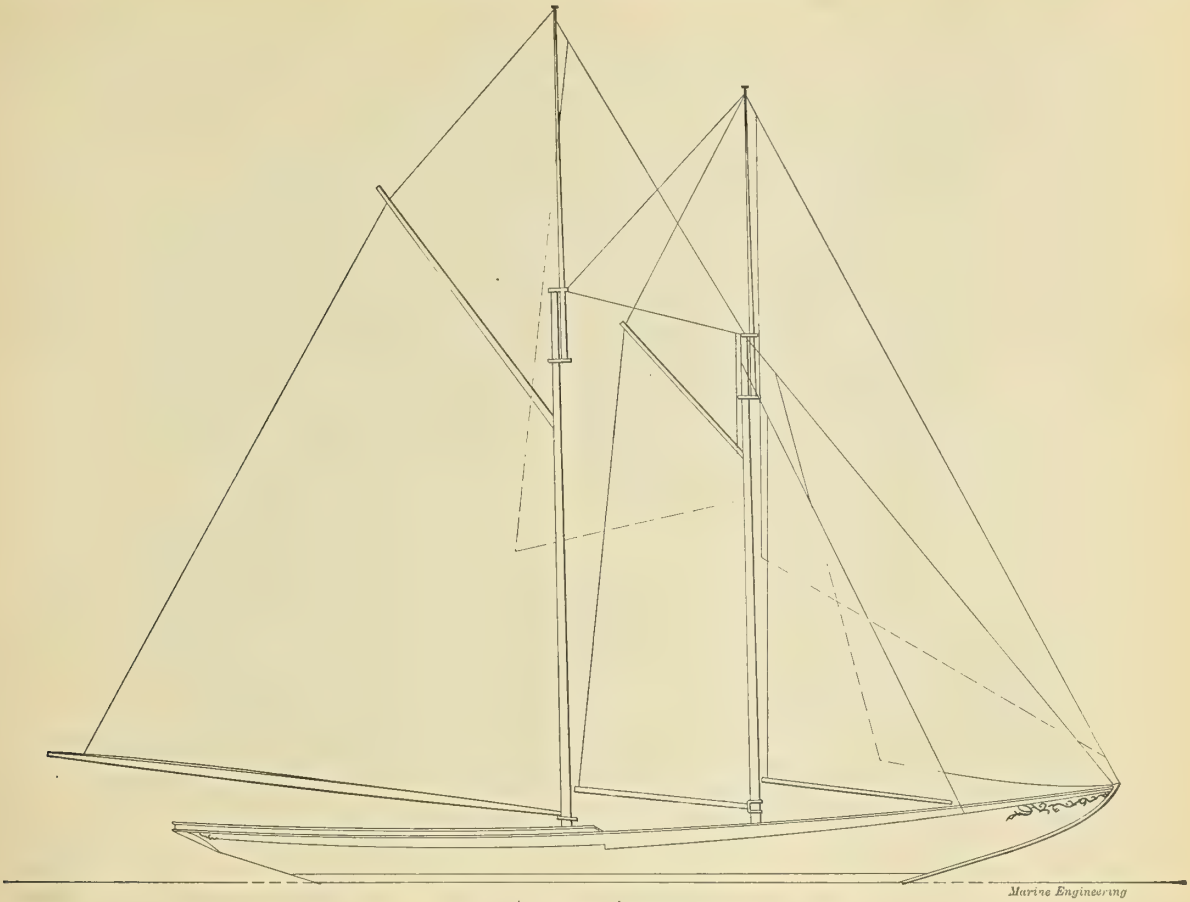
she could tack from full to full in from 20 to 25 seconds, which, needless to say, is wonderfully quick time, for the *Columbia* and *Shamrock* took from 25 to 30 seconds, but it only goes to show how near the crack yachts are the Gloucester fishermen of to-day.

The *Helen B. Thomas* is 106 feet 7 inches over all, 66 feet L. W. L., 24 feet 9 inches overhang forward, 15 feet 10 inches overhang aft, 21 feet 6 inches beam, and 14 feet draft, 9 feet 6 inches depth of hold. The foremast is 40 feet 6 inches inside the stem head. She was built at Oxner and Story's yard in Essex, Mass., and is constructed after the manner of all fishermen. Her keel is 12 inches sided white oak. The frames are molded 7½ inches at the heel, and 5½ inches at the head, sided 6 inches and spaced about 18 inches. The planking is 2½ inches white oak and fastened with oak treenails. The main deck beams are 8 by 8 inches oak with a crown of about 4½ inches spaced about 5 feet. The half beams are 6 by 6 inches oak, one between each main beam. The break in the deck comes on the beam forward of the mainmast. The deck is 3 inches pine in narrow strips caulked and the seams run with marine glue. She carries about 60 tons of iron ballast and besides this on her out trip she will have 10 or 12 tons of ice which answers for so much more ballast. Returning from her trip, of course, she will be loaded with fish.

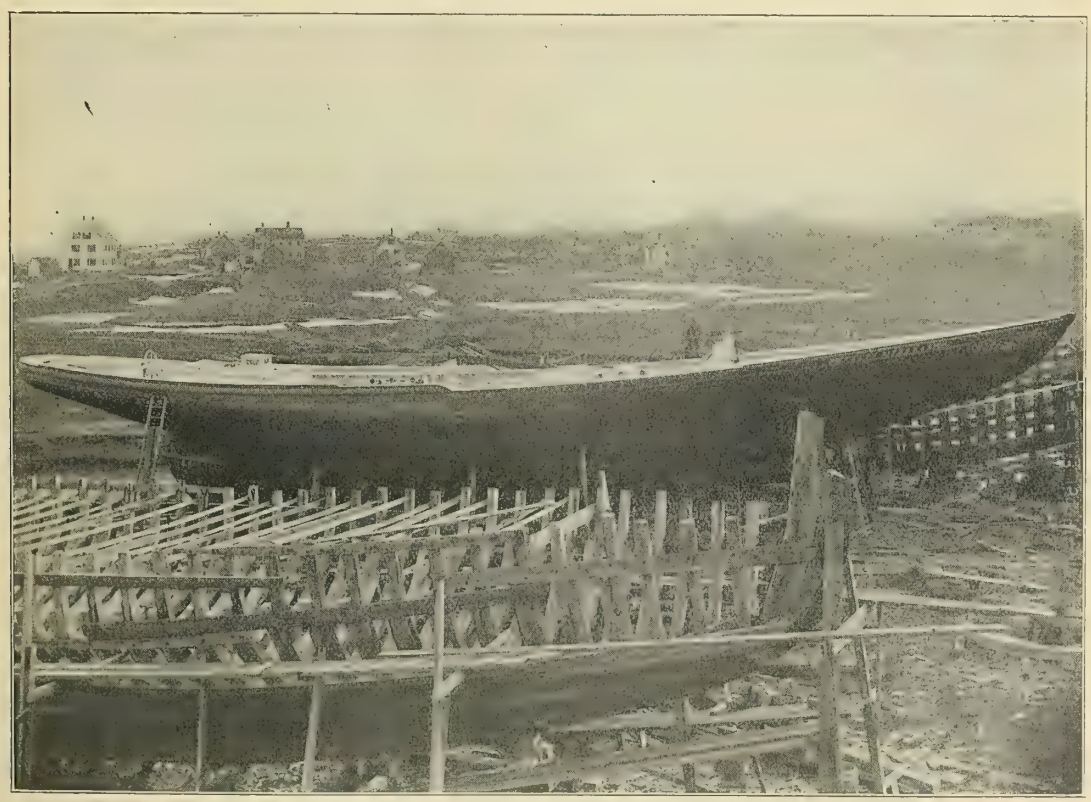
Her cabin is cypress finished bright. The forecastle is pine and whitewood. The cabin is about 11 feet 6 inches long and extends the whole width of the boat. It contains four berths with lockers at the after end for stowing away old sails, ropes, etc. The forecastle extends from the stem to about 12 feet aft the foremast and contains, besides the stove and necessary lockers for cooking utensils, 15 berths in two tiers, 8 on the port side and 7 on the starboard.

This schooner, as well as most of the others that are built in this vicinity, was completely fitted out by E. L. Rowe and Son, who take the schooner from the builders' hands and fit her with sails, rigging, cooking utensils, nautical instruments, and, in fact, everything ready to go to sea. From their books we get the following sizes of rigging and weight of sail, material, etc.: Fore and main rigging three shrouds on each side 2¾-inch iron; jib stay 2¾-inch iron; fore stay 3-inch iron; balloon jib stay 1½-inch steel; fore and main topmast backstays 1¾-inch iron; preventer backstays, 1½-inch iron; spring stay 2¾-inch iron; main topmast stay and counter stay 1¾-inch iron, and main and fore back stays 1¾-inch iron.

For the weight of sail material we get: Mainsail and outer jib, No. 2; foresail, fore staysail and riding sail, No. 1; main and fore topsail, No. 8; balloon jib, 6 ounce; staysail, 10 ounce.



SAIL PLAN OF THE HELEN B. THOMAS.



THE KNOCKABOUT FISHERMAN HELEN B. THOMAS READY FOR LAUNCHING.

Torpedo Boat Destroyers.

In view of the distrust that appears to exist in regard to the structural strength of torpedo boat destroyers and the reliability of the machinery, the following particulars furnished by Mr. Yarrow, bearing upon the structural strength and speeds attained by the destroyers built at his yard may be of interest. Eight torpedo boat destroyers, 220 feet long, having a speed of 31 knots, within recent years have been completed by Yarrow and Company. Six of these have steamed out to Japan, where they were in constant service between China and Japan during the recent Eastern crisis. They have not shown any symptoms of structural weakness. One point that does not seem to be sufficiently appreciated is that the safety of lightly constructed vessels, such as destroyers, is dependent to a very large extent upon the elasticity of the vessel when encountering rough weather, and said elasticity must be as uniform as it is possible to make it, otherwise the bending strain will be concentrated at certain points, overloading the metal, which ultimately will give away. The study of the structural strength of vessels when considered as a girder with a proper proportionment of material to resist the bending and hogging moments, should be very carefully considered by naval constructors.

Considering the extreme delays in this country in completing the official trial trips of destroyers and torpedo boats, it is interesting to note in the following table of Japanese destroyers built by the above mentioned company the interval between the date of launching and the date of the official trial.

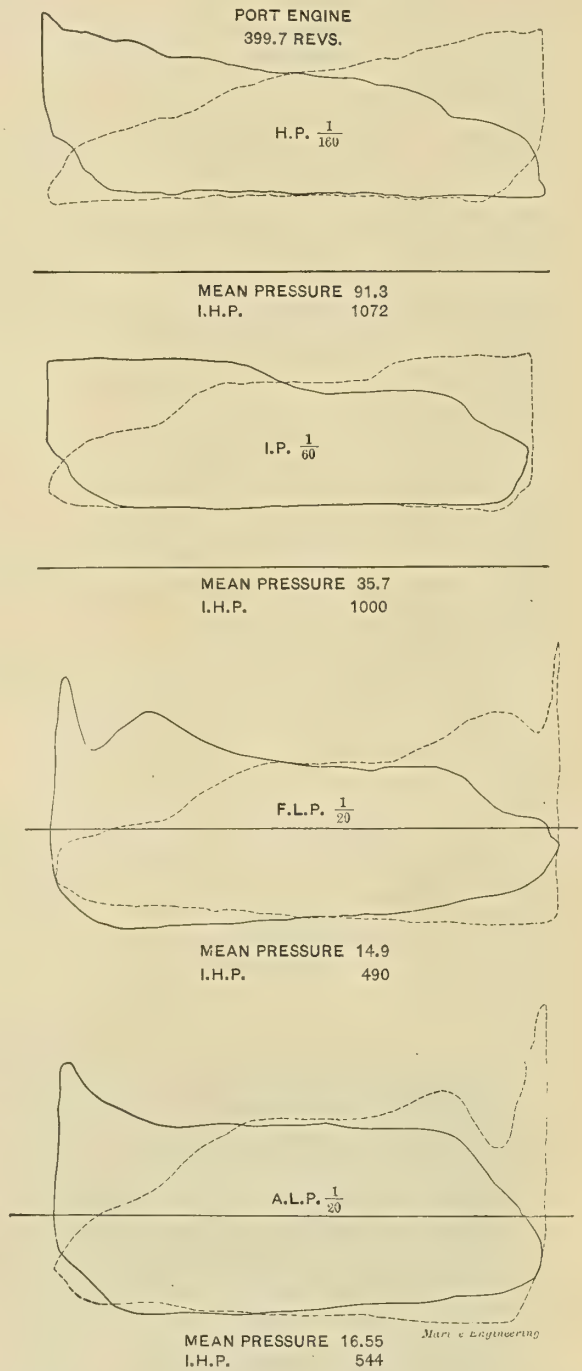
In each case the trial consisted of a run of three hours duration, with a load of 35 tons in the case of the first six vessels, and 40 tons on the two last built. The accompanying illustration is of the engine of the *Kasumi*, which is of the four-cylinder triple-expansion type. The diameters of the cylinders are, H. P. 20 1-2 inches, I. P. 31 1-2 inches and the two L. P. 34 inches. The common stroke is 18 inches.

The lightness and compactness of the design are evident. They are balanced according to the Yarrow-Schlick-Tweedy system with the low pressure cylinders at the ends and the high and intermediate cylinders between. The indicator diagrams of the port engines of the *Kasumi* on her official trial show an even distribution of power and very good adjustment.

The consumption of fuel per horse power on these destroyers varies from 2 to 1 1-4 pounds of coal per I. H. P. per hour.

Name of Vessel.	Date of Launching.	Date of official trial.	Interval between date of launch and date of official trial.	Speed in knots.
Ikadsuchi....	Nov. 15, 1898	Dec. 23, 1898	38 days	31.32
Inadsuma....	Jan. 28, 1899	Mch. 8, 1899	39 "	31.03
Akebono....	Apr. 25, 1899	May 4, 1899	9 "	31.08
Sazanami....	July 8, 1899	July 24, 1899	12 "	31.38
Oboro.....	Oct. 5, 1899	Oct. 14, 1899	9 "	31.26
Niji	Dec. 16, 1899	Dec. 21, 1899	5 "	31.16
Akatsuki.....	Nov. 13, 1901	Nov. 21, 1901	8 "	31.12
Kasumi.....	Jan. 23, 1902	Jan. 29, 1902	6 "	31.24

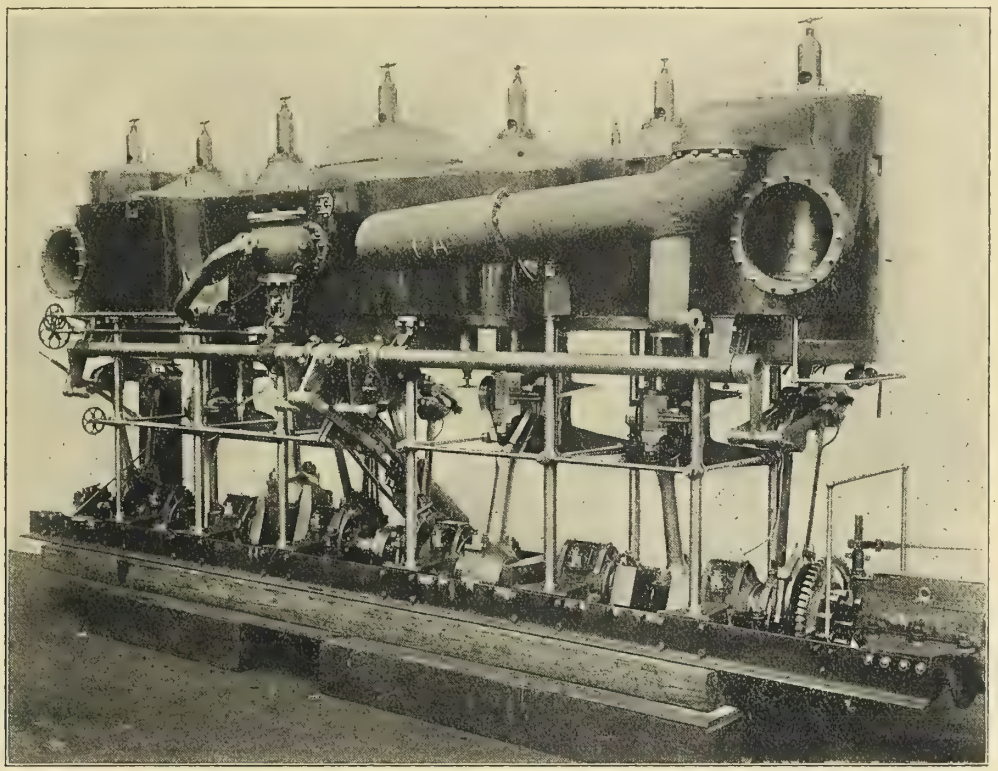
There are four boilers of the Yarrow express water tube type with side tubes, each with a capacity of 1,600 H. P. With water and fittings each boiler weighed 18 tons. Fore and after coal bunkers are located at the sides of the vessel, with a capacity of 90 tons, which gives a steaming radius at a slow speed of 3,900 nautical miles.



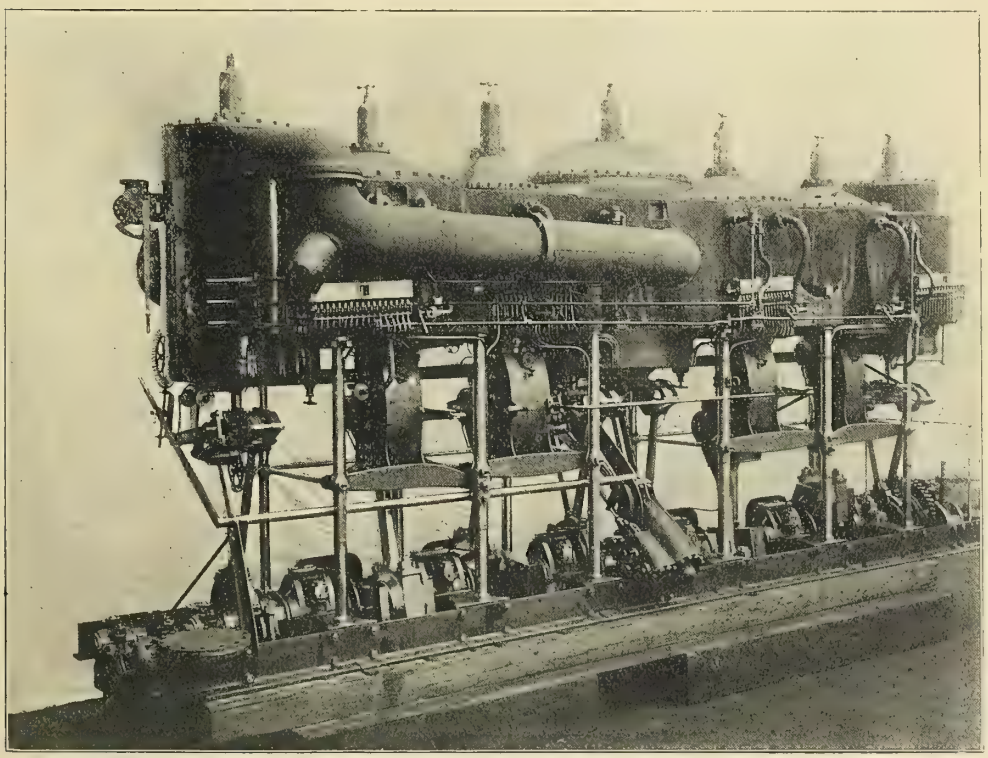
INDICATOR CARDS ON THE PORT ENGINE OF THE KASUMI, COLLECTIVE I. H. P. 3106.

The general dimensions of this vessel are the same as her sister destroyers, viz.: Length, 220 feet 3 inches; breadth, 20 feet 6 inches; draft, 5 feet; displacement, 311 tons.

The armament consists of two 12-pounder and six 5-pounder rapid firing guns and two 18-inch torpedo tubes.



FRONT VIEW OF THE STARBOARD ENGINE OF THE KASUMI.



REAR VIEW OF THE STARBOARD ENGINE OF THE JAPANESE TORPEDO BOAT DESTROYER KASUMI.

Marine Engineering

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THE great steamship combination has during the past month attracted the keenest attention from the entire commercial world. Its development as a natural result of the economic and industrial movements of the present day is, however, readily traced. Intercommunication between man and his fellow is a distinguishing feature of our modern civilization; it is one of the great fundamental facts which differentiate the civilization of the present day from that of 500 or even 100 years ago. Now one of the movements of the age, beginning in marked degree some 15 to 20 years ago, is the centralization and massing of these means of intercommunication under a small number of directive centers. The railroads and the steamship lines are the two great branches of the modern development of ways and means for transportation and communication. This centralization and unification has gone on in the administration of our railroads until it has reached the point where a few closely related interests control the larger part of our great railroad systems. It is then the simplest and most natural thing in the world that the same general interests should seek to control the other great arm of the carrying business, the steamship lines. Railroads by themselves are limited to the territory through which they can lay their rails. The ocean, however, is free; the ship needs no rails and follows no beaten path. With steamship connection, therefore, the railroad is able virtually to extend its lines across the seas and to the uttermost parts of the civilized world. The railroad lines and the steamship lines have, therefore, every reason to make common cause under such a centralized administration as shall insure unity of purpose and efficient direction with minimum expense. We take it that the present shipping combine is nothing more than the working out to its logical conclusion of this general movement toward centralization in the carrying trades which has recently been coming into such great prominence.

As to the results for the public it is, perhaps, too early to attempt any discussion. We are promised increased and better service for mails, passengers and freight. As to the effect on shipbuilding and shipping interests in general but little can be said in advance of more definite information regarding the details of the scheme, and the plans regarding construction, repairs, etc.

Until we have further information as to details we should, perhaps, suspend judgment as to these various points, and in the meantime watch with interest the development of this latest manifestation of the spirit of the age.

ON another page of the present issue we print a description of the equipment of the canal of the hydraulic laboratory of Cornell University for experimental research relating to the resistance and propulsion of ships. The general installation and equipment of this laboratory have been proceeding for the past three or four years, but it is only within the past year that a start could be made upon its equipment for research in the directions above noted. From the description of the equipment, as now installed, it will be seen that the present line of investigation has chief reference to the performance of screw propellers. In the whole field of Marine Engineering and Naval Architecture there is, perhaps, no single problem which is more complex or which depends upon a larger number of varying conditions interacting in marvelously intricate ways upon the final performance.

This has long been a favorite field for the mathematician and the theorist, though it must be ad-

mitted that their work has had but small influence upon the practical design of screw propellers for conditions which arise in ordinary practice. Such design always has, and from the nature of the case, always must rest upon experience either with full-sized propellers or as drawn from experimental research with smaller models. It may be fairly said that in the present condition of our knowledge regarding the screw propeller, what is needed is a larger storehouse of facts rather than further attempts at theoretical discussion. Without such facts all theory will be fruitless; with them it will be of aid in their interpretation and intelligent use.

As to the reality of this need, no detailed discussion is required. It is true that for the average case of marine design, where the conditions are easily fulfilled and where existing experience is wisely used, there is no difficulty in designing a propeller which shall efficiently fulfill the conditions imposed. Where these conditions, however, are somewhat extreme, or where it is desired to depart somewhat from the broad path of average practice, need is immediately felt for more exact information. An illustration of this is found in the United States torpedo boats and destroyers now under construction and on trial. In many cases these have been fitted over and again with propellers of varying characteristics in the hope of bettering the performance in one way or another. With adequate information such groping in the dark would be unnecessary.

It is understood that the purpose of the equipment above referred to has especial reference to the further detailed investigation of screw propellers in the hope that this margin of uncertainty may be somewhat reduced. It is understood, furthermore, that the facilities here available for the investigation of such propellers are intended for the use of the engineering profession at large, and especially for the shipbuilders of the country. With competition ever increasing in keenness there is a corresponding need for accuracy and certainty in all features of design, and it often happens that the margin of profit may be largely or even entirely wiped out by some failure to realize on the first trial the full possibilities inherent in the conditions imposed. This equipment and the facilities here available are intended as an aid to the American shipbuilder in the elimination of some of the uncertainties which thus arise in the practice of his art.

Those who may be interested in the use of such facilities for research should communicate with Professor W. F. Durand, of Cornell University, who has charge of this work and from whom details regarding facilities for investigation in this field of engineering practice may be learned.

IN spite of the oft-made charge that we are giving an undue amount of time and energy to the various activities making up the strenuous life of the average American, it is, nevertheless, a fact that an increasing amount of time is devoted from year to year to the various means of recreation and amusement. We are apt to pursue these means of recreation, however, in the same spirit in which we pursue the business aim, and it is perhaps for this reason that the automobile and motor launch take so prominent a part in providing for diversion from business cares. Either of these, however, requires some skill and some small acquaintance with engineering matters for its proper operation and care, while from the very nature of the case many are operated by amateurs in engineering matters. It is, therefore, desirable in the highest degree that machinery of this type should be reduced to its simplest form and that its care and operation should be made to depend upon the smallest number of simple manipulations and adjustments.

It is a fact, however, that motors of the gasoline type can hardly yet be considered as having reached a final stage of development. In many ways they involve peculiar features and often present puzzling problems to the amateur engineer. The season for the motor launch is now at hand and everything indicates an increasing use of this type of boat for the coming summer months. It is for these reasons that we have been at pains to provide for readers of MARINE ENGINEERING as much practical information as possible relating to the operation and care of such boats.

Articles treating this subject will be found elsewhere in the present issue. Their authors will be recognized as men who have had wide experience in this field and who are qualified to speak with authority on such subjects. It is hoped that these articles, together with other similar matter which will be provided, may prove of aid to those interested in such boats, and especially to the large class of those who have not been trained as engineers, but who take an intelligent interest in the principles relating to the operation and care of machinery of this type.

MISHAPS AND REPAIRS.

An Apprentice's First Experience.

Several years ago I was an apprentice at a shipyard on the Tyne, and was started in the drafting room. The chief-draftsman gave me the simplest kind of work, and mostly tracing at that, and, after a few months, I began to feel as if I was not finding the proper opportunity to get ahead. So one day when I was telling my troubles to the chief-engineer of one of the ships which was at the yard for engine repairs, he advised me to try to get some sea experience, to which I enthusiastically agreed, and he said he would do what he could to help me.

The new freight ship *N*——— was about to leave for Marseilles, and through my friend's efforts I was taken along as a donkey boilerman. On a ship where there are three engineers besides the chief, a donkey boilerman, who ranks next to the third-assistant engineer, is on the first-assistant's watch, and is at the beck and call of his superiors both on and off watch. Before we had been out very long the crank pits became filled up with the water which was used to cool the bearings which had been running hot. Chains are run through the limber holes in the fore and afters of the engine foundation, so that when these holes are clogged up all that is generally necessary is to pull the chain from one side to the other. However, this would not clear the limber hole, and every time the crank came around a shower of water was sent against the back of the engine, so the first-assistant told me I would have to clear it out.

Anyone who has been in an engine room at sea knows what a filthy hole the crank pit becomes with oil and grease. The only thing for me to do was to crawl in through the side under the engine bed plate, in a space just large enough to wriggle through, and reach into the pit, and pull out the waste which some careless oiler had thrown away. At the time, as I lay on my back, I was in grease and water which came almost up to my mouth.

But I only had to do this once on the voyage. The boilers gave us all kinds of trouble and no less than sixteen tubes gave out on that short trip, and I was called upon sixteen times to crawl through the furnace into the combustion chamber and put the washer and nut on the bolt which was passed through the tube from the front. The steam was not reduced, however, on the boiler, only the fire and grate bars were removed and the bridge wall covered with sacks of sand. Over these I crawled, feeling like a boiled lobster, and I never worked so fast on any other job as while putting the washer and nut onto the bolt and getting back again.

I did not realize at the time how much valuable experience I was gathering, but was glad indeed to get back to the yard and continue in the drafting room.

The plan of promotion for apprentices from one department to the other was really as rapid as advisable. Before many months I had passed through all the departments of the machine shop, had some experience in fitting and was again back in the drafting room as a full-fledged draftsman. I believe that the English apprentice system is a decidedly good thing for the men, as it compels the apprentice to gather experience in several branches before he can become a full-fledged mechanic or artisan in other branches. In my opinion it is absolutely necessary for a first-class draftsman to have some experience in the shops, and, if all of them could have such experience, we should find more practical designing. W.

Repair of a Winch for a Traveling Crane.

The frame of the winch was broken as shown by the line AB in the figure. The following is the description of the method of repair adopted. The following material was required:

(1) A piece of wrought steel C.

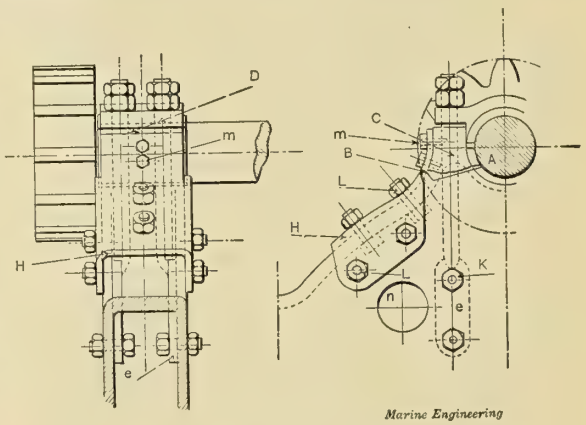
(2) Two bolts D with flat part at *e*, bolted to the frame as shown.

(3) A piece of one-half inch steel plate H, bolted with the piece C.

The operations were carried out as follows:

(1) Clean off the fracture AB in a right line so as to have a little recess at B.

(2) Form the piece C, fit it to the prepared surface of the fracture and mark the holes for the two bolts D. Then dismount the piece C and drill the holes as marked.



ILLUSTRATING REPAIRS MADE TO A WINCH.

(3) Make and fit the two bolts D, securing them by the small bolts K.

(4) Fit the piece C in its true position relative to the bolts D.

(5) Make and fit in place the piece of steel plate H.

(6) Mark and drill the holes in this piece for bolts L and for screws *m*.

(7) Fit the piece H and mark the holes on the frame and on piece C and then dismount it.

(8) Drill the holes for bolts L, then drill and tap the holes for screws *m*.

(9) Fit the piece H. Tighten the bolts L and screws *m*. These bolts were introduced by the hole *n* in the frame.

(10) Fit the shaft and upper part of the bearing.

This repair was made eight or nine years ago, and the winch is still in regular service.

A Boiler Repair.

The following accident and the repairs made to the boiler took place in the Indian Ocean, aboard a British tramp steamer of about 2,200 tons, the ship having a triple expansion engine of 1,800 horse power, and 2 single end Scotch boilers, each boiler having 3 furnaces

fitted with Adamson rings. The steam pressure carried was 120 pounds per square inch. Owing to the fact that the high-pressure cylinder was fitted with a double-ported slide valve without a relief frame, large quantities of cylinder oil were used to facilitate the working of this valve, for without this liberal use of oil the valve would grunt and the engines would vibrate in such a fashion so as to make the ship tremble from stem to stern. The vessel was also fitted with an Edminston filter, which was in the feed line for the purpose of removing the oil from the feed water, but all these filters are fitted with by-pass valves which allow the feed water to pass to the boilers without going through the filter, and this particular one was not an exception.

The chief engineer was one of the old fashioned kind who did not believe in new-fangled additions to the engine-room; and so, after the cloth in the filter had become choked with grease, thus increasing the pressure on the feed pump plunger, the worthy chief, instead of renewing the cloth toweling, simply opened the by-pass valves, and so the oil was allowed to enter the boilers with the feed-water.

All went well for several days, until about five days before the welcome sight of land was to be expected, when the third engineer then on watch, noticed that the crown sheet of the middle furnace was coming down. He immediately closed the fire door, and not a moment too soon, for the furnace kept coming down until it touched the grate bars, and then the furnace opened up, the hot water coming through the crack. The engineer on watch immediately sent up for the chief engineer, in the meantime closing the stop valve on the boiler and lifting the escape valves, putting on the feed and drawing the other two fires.

The boiler being disconnected and all the fires being out, the feed was shut off and the boiler blown down. Men were sent into the boiler after it was comparatively cool, and the oil washed off the other two furnaces, but the low furnace was in bad shape, having opened out for its whole length. This furnace was beyond repair, but the chief was a resourceful man, and decided to put this boiler in commission again if possible. Luckily the ship had a cargo of cement, and taking six barrels of this stuff into the fire-room, the chief proceeded to show the younger men how to repair this boiler. The grate bars were taken out and a plate was put at the end of the furnace at the combustion chamber, and then the cement was put into this furnace right against the plate, filling the furnace up solid with cement, and at the front end another plate was fixed to hold the cement in position until it had hardened. The furnace was simply a mass of solid cement, and after waiting some time for this to harden, the boiler was filled up again with water, steam raised, and the vessel went ahead with five fires instead of six.

The cloth in the Edminston filter had in the meantime been renewed and the boilers were carefully watched for more furnaces coming down, but nothing further happened and the voyage was safely finished. On arriving at the Indian port the boilers were thoroughly cleaned, but no new furnace was put in, Lloyds inspector being satisfied to have the vessel return to England as she was, without making repairs to the boiler, and everyone who came aboard complimented the chief engineer upon his ingenuity. After this little accident great attention was paid to the oil-extractor, and the voyage ended without further mishap.

EX WHY ZEE.

Explosion of Boiler Pipe.

While I was in the engineer's force on board the British steamer ——, a very serious accident occurred in the main steam pipe while waiting in a South American port. Upon later investigation it appeared that the primary cause of the explosion was defective brazing, therefore, I send you this account, believing it to be of interest to your readers.

The pipe was 6 inches internal diameter, made of copper .22 inches thick with brazed lap joint. We were carrying 130 pounds steam pressure preparing to leave port, when suddenly the pipe ruptured along the seam for a length of 2 feet 6 inches opening at the center of rupture to 1 foot 6 inches. It was torn from the flange connecting it with the stop valve of the port boiler, thereby permitting steam from both boilers to escape. One man was scalded before we were able to draw the fire and close the stop valve and reduce the boiler pressure. We then found that the lap was only 5-8ths of an inch at the widest and in one place where the rupture probably started, the lap was only 1-4th of an inch in width and the outer edge of the same had wasted away in the process of brazing. The inside surface was heavily pitted, the copper plate being reduced in places to .1 inch in thickness. It was also found that there was not sufficient solder along the seam to make a joint.

We later examined all of the steam pipes and tested them under a water pressure of 250 pounds, which pressure developed many weak places in the various lines. These parts were brazed and patched so as to carry the steamer back to her home port, where entirely new piping was fitted.

J. A. N.

ENGINEERS' DICTIONARY, XXXVI.

Prime (to) or **Priming.** See under **Foaming.**

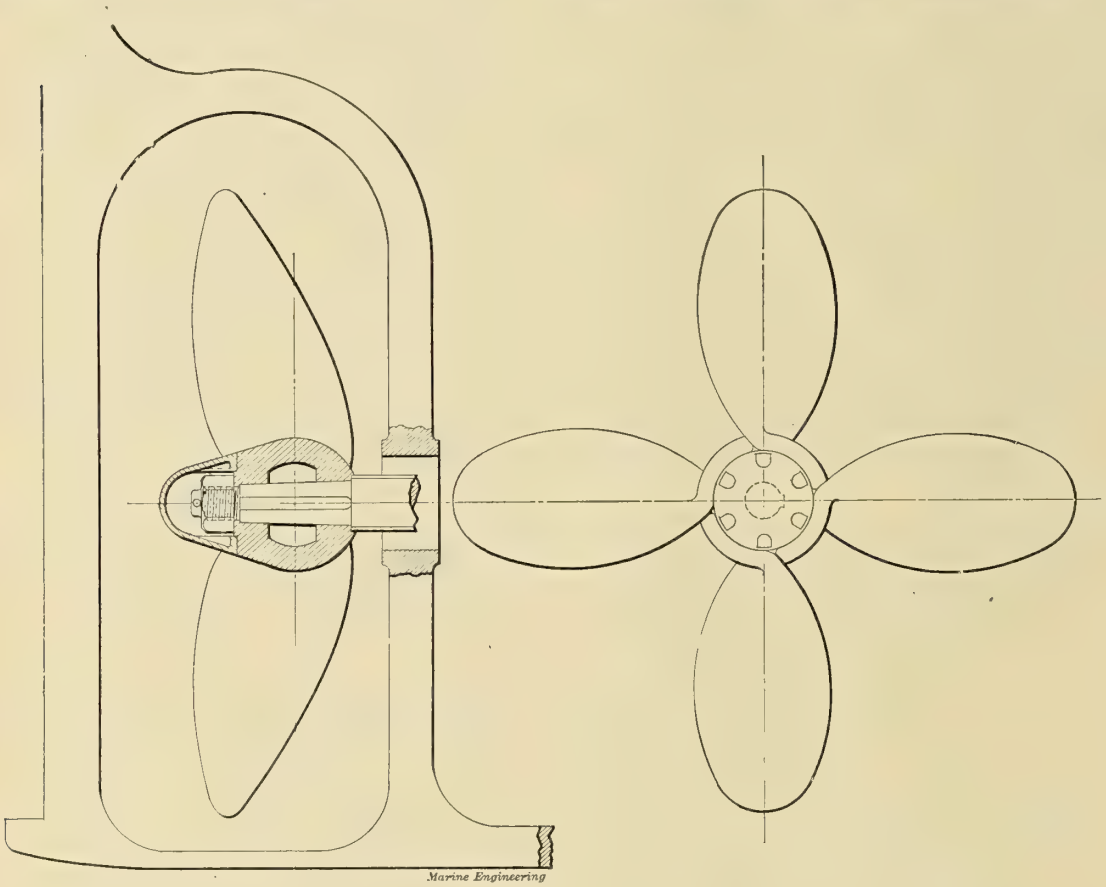
Propeller. An instrument for propelling a ship. The term usually implies, however, a screw or helicoidal propeller, as shown in the figure. Such a propeller may consist of two, three, four or even more blades attached to a hub which is carried on the propeller shaft, and by means of which the blades may receive a motion of continuous revolution in the water at the stern of the ship. The faces of the blades are parts of helicoidal surfaces; that is, surfaces similar to those forming the sides or flanks of an ordinary square thread on a bolt. It will be noted that the face is the *after* surface of the blade. The *back* or forward surface has such form as may result from the thickness given to the blade.

From the form of the blades it results that when the propeller is made to revolve the water about the stern of the ship is set in motion with an accelerated velocity directed aft. From the laws of mechanics it results that the propeller itself will be acted on by a force from the water resisting this acceleration and directed forward. This gives the propulsive thrust which is transmitted to the shaft, and then through the thrust bearing to the

ship itself. The number of blades in modern practice is usually three or four. When the propeller is of moderate or small size the blades are usually all made in one piece with the hub. When the propeller is large they are very frequently made separate with a flange or boss at the inner end by means of which they are secured to the hub with stud bolts and nuts.

If the blades are so placed that when driving the ship ahead, the propeller when viewed from aft looking forward turns with the hands of a watch, it is said to be *right-handed.* If it turns in the opposite direction it is said to be *left-handed.*

The *leading* and *following* edges of a blade are respectively the forward and after edges.



The *diameter* of a propeller is the diameter of the circle swept by the tips of the blades.

The *area* or *developed area* or *helicoidal area* of a blade is the actual surface of the driving face.

The *projected area* is the area of a projection of the blade on a transverse plane, or as viewed from aft looking forward.

The *disk area* is the area of the circle swept by the tips of the blades.

For the definition of *pitch* see under that head. If the pitch is the same for all parts of the blade the propeller is said to be of *uniform* pitch. If it varies over the face of the blade the propeller is said to be of *variable* or *expanding* pitch.

In the case of small boats driven by gasoline or other like motors, it is often desired to avoid reversing the engine, and to this end the propeller is sometimes made with reversing blades. In such case they are usually two in number and are mounted in the hub in such way that by means of a lever their obliquity may be changed from right to left or *vice versa.* In this way the engine may be run always in one direction, while the propeller may be made to drive ahead or back as may be desired by an appropriate adjustment of the controlling lever.

Quadruple Expansion Engine. An engine in which the steam is expanded in four cylinders of continuously increasing volume, or in which the expansion of the steam is carried out in four successive stages. The first or smallest cylinder is known as the *high pressure* or *h. p.*, the second as the *first intermediate* or sometimes the *first m. p.*, the third as the second intermediate or *second m. p.*, and the fourth and last as the *low pressure* or *l. p.* The ratio of the volumes between the h. p. and l. p. is usually found between 8 and 10 in modern marine practice. This, with the usual point of cut-off in the h. p. and allowing for the influence of clearance, will usually give a total expansion ratio of from 12 to 15.

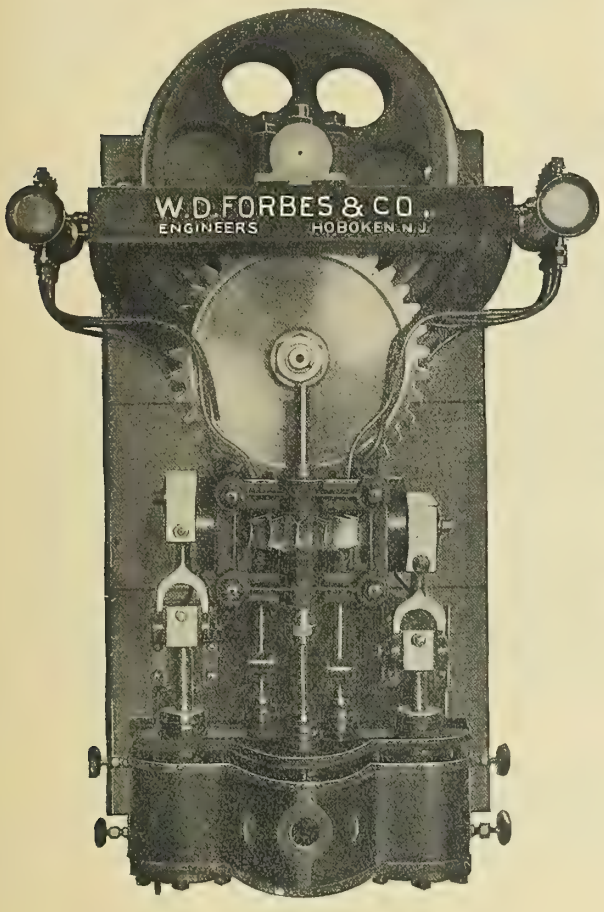
Speed of Torpedo Boats.—Owing to the difficult experienced by the builders of torpedo boat destroyers in attaining the contract speed of the vessels, the Navy Department has decided to reduce the required speed of boats built from departmental plans to 26 knots.

ENGINEERING SPECIALTIES.

New Type of Steam Steering Engine.

In looking over the subject of steam steering engines, but few types are found in the United States, while in England they seem to be very numerous. This seems not unnatural when it is remembered that English practice often demands that everything for a ship should be made in the yard or on the premises, while in America the work of specialists in various lines is generally purchased.

There is really as much individuality in design as in

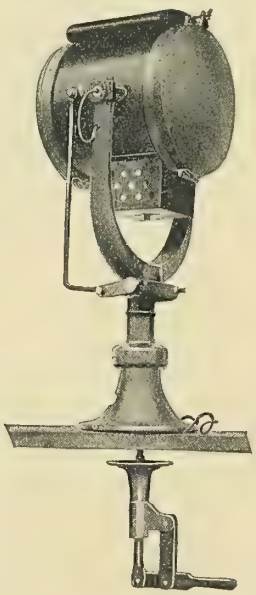


A NEW STEAM STEERING ENGINE.

persons, and there are many engineers who can tell at a glance where a piece of machinery is made, even if it is the latest product of the shop. Anyone knowing the previous designs of the W. D. Forbes Company, of Hoboken, might at once place to its credit the illustration herewith shown of a steam steering engine. This company has always held to well recognized and tested forms, modified for the particular conditions under which they are to be used, and its latest product is a very neat and satisfactory arrangement of mechanical details. The steering gear is arranged so as to be used either vertically or horizontally, the only change being in the modification of the oiling system, which is of the sight feed drip class. The cylinders of the engine are fitted with piston valves working in liners, the ports of which are machined, the floating or controlling valve being also of the same construction. The piston rods and crossheads are forged in one piece, and their brasses are fitted into slotted eyes with wedge adjustment. The connecting rods are treated in the same way on the crank-pin end, while on the cylinder end they are of the usual forked type, the crosshead pin being of generous size and of tool steel. The crank, eccentric and worm are all in one piece and of forged steel, and the bearings are provided with an adjustment for wear. This makes a very solid, yet light construction. The valve stems and eccentric rods are of steel, and the eccentric straps are of composition. The worm wheel is of bronze made to take up wear on the teeth by the well-known system of making the wheel in halves and providing a fine adjustment for same. All the bearings are very large and admirably oiled. The small worm wheel placed horizontally in front of the machine controls the floating valve and returns it to a natural position by meshing into the worm on the crank shaft, thus making an extremely simple arrangement. Throughout the engine Katzenstein's metallic packing is used, and the lagging is generally of copper. The W. D. Forbes Company has made several sizes of such steering gears, and adapted them for direct driving, when required, to the tiller head or for rope transmission, as is shown in the illustration. While this gear is stocky and strong in the extreme, it is light when compared with other types. Quite a number of these gears have already been sold, and seem to be very satisfactory. With these engines, when required, steering column and wheels are also furnished.

Search Light Projectors.

The advantages gained by the use of search lights on steamboats are becoming so well known that river



SEARCH LIGHT FOR PILOT HOUSE.

and harbor craft, as well as steamships, are often equipped with one or more projectors. In taking up buoys, in entering harbors and landing at docks, they lessen the difficulties of navigating at night.

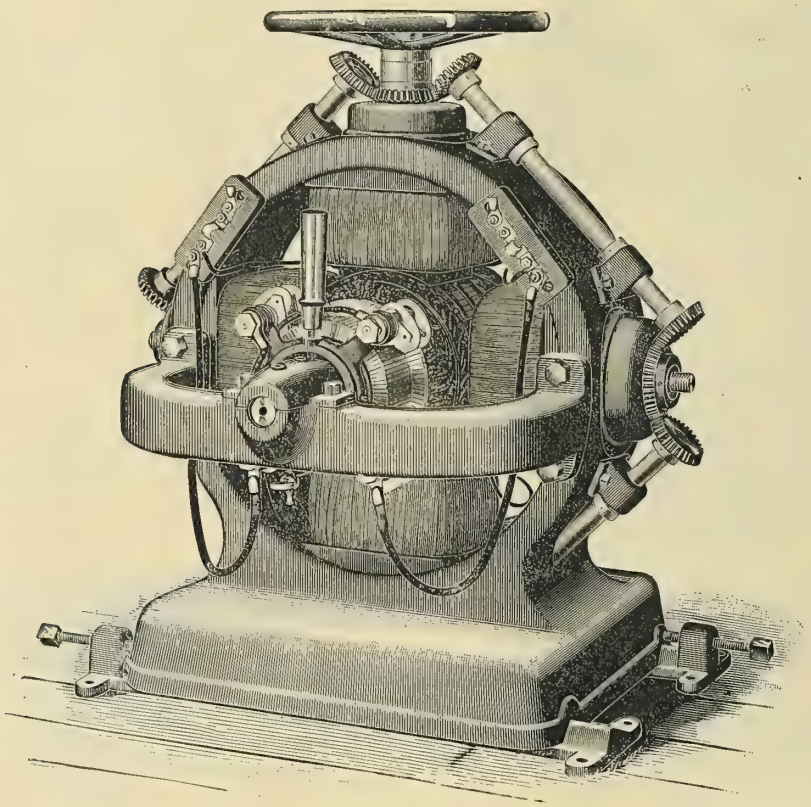
They are also a protection and an advertisement for passenger vessels. The pilot house lamp, here illustrated and manufactured by Enberg's Electrical and Mechanical Works, St. Joseph, Mich., is designed to meet these various requirements. The Mangin type mirror is used. This lamp can be either placed on the pilot house and operated by one handle from below, or, if desired, it may be placed at any point of the ship, and still be operated from the pilot house by cable system.

The Stow Multi-Speed Motor.

The new type of four-pole, "Multi-Speed" motor, illustrated herewith, combines all the advantages of the ordinary multi-polar motor, with the added advantage of an operative speed range of 100 to 150 per cent. from minimum speed, the percentage of speed variation increasing with the size of the machine. The armature rotates in a balanced magnetic field under all conditions of speed, this magnetic balance being secured by a simultaneous radial adjustment of the four "plungers" by means of bevel gearing, a hand wheel by which the plungers are moved being located conveniently at the top of the machine. The design of the pole pieces and the selection of gearing is such that no great effort is required at the hand wheel in order to move the plungers against the tractive power of the field magnets. As the gears are small and the gear rods lie close to the frame of the motor, this mechanism does not detract from the otherwise symmetrical and pleasing design of the machine. While the cut shows an open type machine, the design is such that if an inclosed motor is desired the armature supporting brackets may be removed and the ends of the frame finished so as to receive suitable inclosing heads, in the center of which the armature bearings are arranged.

The 6 H. P. machine, shown in the cut, is designed for a minimum speed of 700 R. P. M., the maximum speed being 1,500 R. P. M., giving a total speed variation of 115 per cent. at any speed, between which limits the machine develops its full rated H. P. with an efficiency of only 2 per cent. less at its maximum than at its minimum speed.

When the plunger is adjusted so that its inner end comes in contact with the pole shoe, the magnetic circuit is most complete and of minimum reluctance, and, since the M. M. F. of the field coil remains constant, the volume of magnetic flux becomes a maximum and the speed minimum, or normal. As the plunger is drawn away from contact with the pole shoe a column of air is interposed which gradually increases the reluctance of the magnetic circuit as long as the plunger continues to be withdrawn. When the plunger reaches the limit of its outward motion, the reluctance of the magnetic circuit, and hence the speed, becomes maximum.

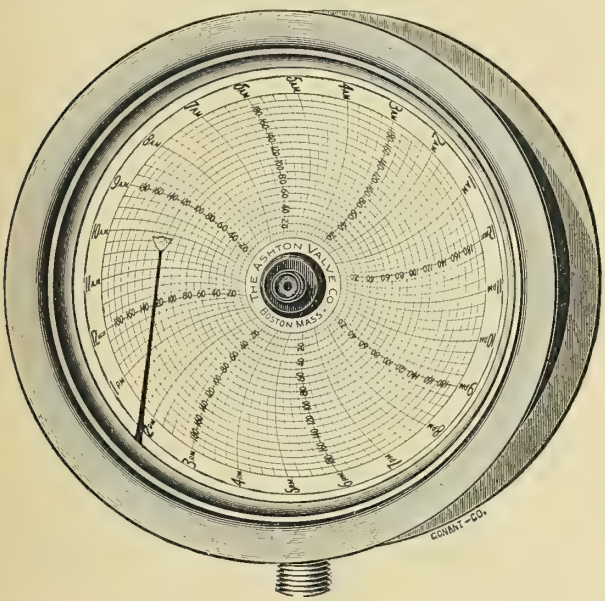


FOUR-POLE MULTI SPEED MOTOR.

It should be understood that while the motor carries its full load, sparklessly, at any imaginable speed within its range at practically maximum efficiency, it will also carry any lesser load with a consumption of power corresponding with the actual work done. As the speed regulation is effected solely by varying the reluctance of the magnetic circuits, no "controller" or rheostat or re-

sistance of any kind is used in the regulation of the speed, all electrical circuits and connections remaining unchanged through the entire range of speed.

The machine illustrated represents a type which is being built in sizes 5 H. P. up to 25 H. P. For sizes above 25 H. P. automatic means can be furnished for varying the speed. It is a fact worthy of emphasis that the special advantages offered by these motors are obtained without the sacrifice of any advantageous feature possessed by other machines of ordinary type, the efficiency being in every case fully up to the standard of first-class modern practice. It is interesting to note that in all other motors, the number of operative speeds corresponds to the number of steps in the controlling device, while the motor herein described possesses a speed range of absolute continuity; in other words, between the maximum and minimum limits an infinite number of speeds may be obtained without the use of any controller or rheostat. These motors are made by the Stow Manufacturing Company, Binghamton, N. Y.



A PRESSURE RECORDING GAUGE.

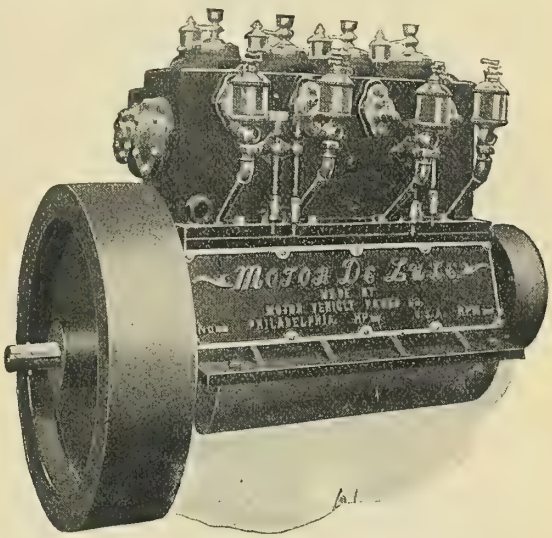
Recording Gauge.

The Ashton pressure recording gauge, illustrated in the above cut, is a combination of a pressure gauge and recording dial or chart. By its use a record is given showing the exact pressure carried, with its variations both day and night, with the time and duration of all changes. It is equally adapted for steam, water, air or gas pressure and is a most valuable instrument to have for any conditions in which a record of pressures is desired. When used at a boiler plant, these gauges serve as an incentive to careful firing and steady steam pressure, as any omission of duty or carelessness becomes recorded by the use of this gauge. The instrument is distinctly a high grade one. The clock movement actuating the dial is a fine instrument and is placed in an insulated case, so that should there be any leak in the gauge spring, the movement would not be injured. The dial is graduated for every 10 pounds pressure and every quarter of an hour, and is also figured so that one can tell at a glance while the dial is on the gauge what the actual pressure at the time is. The hours are also carefully marked A.M. or P.M. to avoid confusion.

The instrument is adapted for marine service and can be placed away from the boilers, in the pilot house, engineers' or captain's room or in all three. The gauge is made by the Ashton Valve Company, 271 Franklin street, Boston, Mass.

Motor De Luxe.

Simplicity, durability and strength, together with high efficiency and a large actual horse power per weight of machine, are claimed for the Motor De Luxe, which is made especially for marine purposes. This motor is made with four cylinders and is of the four cycle type. Gasoline is vaporized and led into the top of each of the four cylinders, the charge for all being regulated by one throttle valve. The cam shaft for operating the valves is geared to the main shaft and a different point



FOUR CYLINDER MARINE GASOLINE ENGINE.

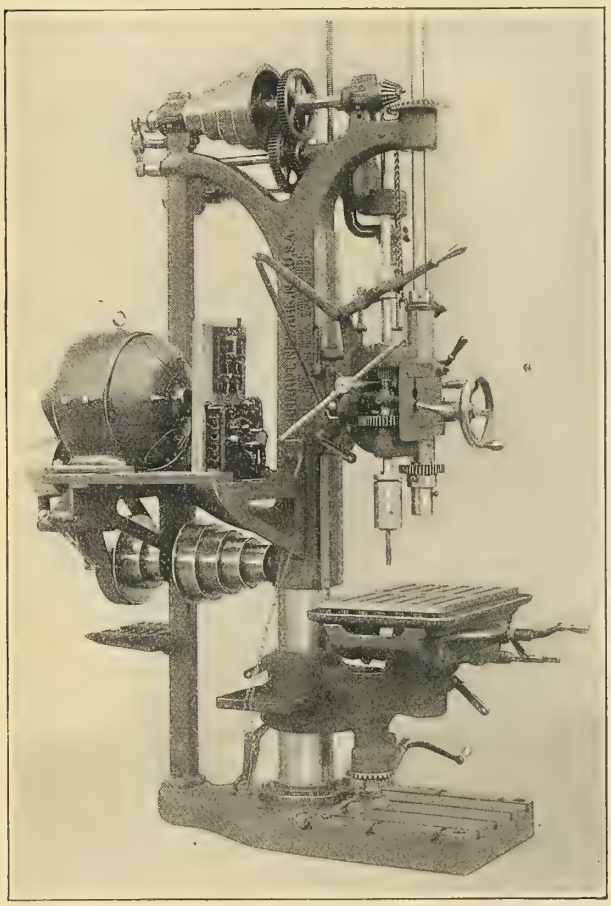
of cut-off is obtainable on all of the four cylinders. All the valves have positive motion. The sparking device for each cylinder is easily removable from the cylinders, and the point of sparking can be regulated. The tripping device for drawing the sparking has also motion from the cam shaft. The crank is a single forging, and the outer cylinders have their cranks set at 180 degrees from the two center cylinders, thus reducing to a minimum the vibration. An ignition occurs in a cylinder every two revolutions, so that in the four-cylinder type there are two impulses given to the crank at every revolution. These impulses, because of the crank angles, occur at equal intervals.

The motor is handsomely finished. A dynamo is supplied which can be thrown on in place of the batteries when the motor is under way. The three horse power motor has but two cylinders, and the larger motor has four cylinders.

Further particulars may be obtained by applying to the Motor Vehicle Power Company, 1221 Spring Garden street, Philadelphia, Pa.

Standard Drill Press.

The accompanying cut illustrates the latest improvements which have been made in the 25-inch upright power feed drill press made by Gould and Eberhardt, Newark, N. J. The illustration was made from one of a lot of machines which have just been shipped to the new United States Government Printing Office at Manila, P. I. The table and table arm are now raised by bevel gear and screw placed about central between the center of the column and the drill spindle, thus equalizing all strains and weights brought to bear on the table.



VERTICAL POWER FEED DRILL PRESS.

To the left of the drill spindle proper is shown the tapping attachment, which is used for tapping holes after they have been drilled, the work being rapidly moved across and centered under the tap by means of the oblong, compound traverse table. After it is set and started it will go to the proper depth, reverse and run back, and is ready again for the next hole. It is provided with a safety friction device which relieves the strain and prevents the tap from breaking should it strike the bottom of the hole or from any cause become fast in the work.

The method of arranging direct connected electric motor is also shown. The bracket which supports the motor is bolted to the upright columns of the drill and belted direct from armature shaft to driving pulley, and the switch for the motor has been placed where it can be quickly and conveniently got at by the operator. The table and base plate are large and sufficiently braced to maintain perfect rigidity of the machine. The column is practically one casting. The back brace to the column counteracts the pull of the cone belt, and thus prevents any possible springing or deflection of the column. An index placed over each step of the *lower* cone tells the operator the correct belt speed at which to run the various sized drills. An index placed under each step of the *upper* cone tells the operator what speed to run when back gears are engaged. This system not only eliminates guesswork and the burning of drills, but guards against "loafing" on the part of the operator. An index is also placed on the feed rod which tells at a glance the proper feed for any size drill within the range of the machine. The feed is entirely independent of the drill spindle, and changing the speed of the drill does not affect the feed arrangement.

An automatic stop and depth gauge throws out the feed after the drill has reached the required depth. The back gears are arranged so that one movement of a lever releases the cone from the shaft and engages the gearing. The spindle is provided with means for compensating all wear which may take place in the quill by means of a double conical bearing. Spindle head is vertically adjustable and can be raised or lowered and clamped in position. A square quill is used in place of the usual round sliding barrel. T slots run out to the edge of the table and base so that work can be bolted very close to the edge. The slots are of such a size that standard square-headed bolts will fit at once without having special ones forged.

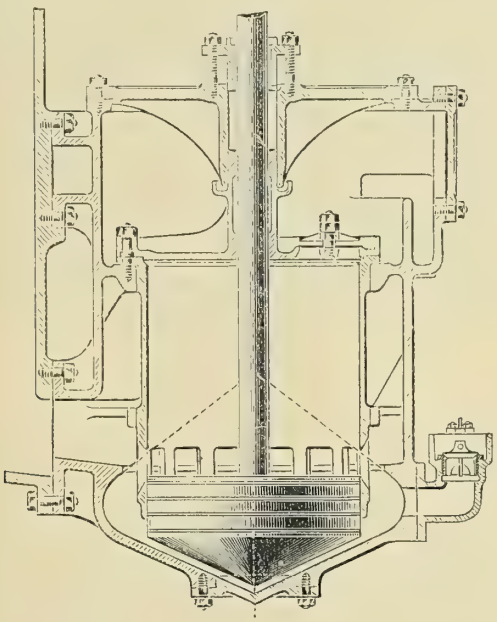
It can be made to feed either automatically or by hand, up or down, separately through the head the entire length of planed surface on column or independently through the rack on quill. All changes are made from the front of the machine, thus allowing the operator to remain in one position directly before his work. It is a rigid, accurate and substantial drill, and with proper care will last a lifetime.

The Edwards Patent Air Pump.

That the Edward Air Pump has been adopted by the leading marine engineers of Great Britain and has been fitted to over 500 vessels, many of them twin screws, is a sufficient endorsement of its reliability, economy and efficiency. In fact, for both marine and stationary purposes the total number of these pumps built exceeds 1,400. In this pump the prime requisites of a successful air pump are combined; namely, simplicity of design and construction, together with a very high standard of efficiency. The action of this pump is illustrated in the sectional view. It will be seen that no foot and bucket valves are used, the only valves being those that in other types of pumps are called head valves, but in the Edwards pump are called "the valves." The condensed steam flows continuously by gravity into the base of the pump, the plunger descends and uncovers the ports, admitting the air freely into the cylinder. The conical face of the plunger strikes the water, which is projected without shock through the ports into the

cylinder. The plunger then rises, closes the ports and sweeps the air and water before it, discharging them through the valves that are in the head of the cylinder. By this method of handling, the water is dealt with mechanically and its action is in no way dependent upon the pressure in the condenser, therefore an increase of speed does not impair its efficiency. In fact, very high speeds may be maintained.

In the old type of air pump, the pressure in the condenser has to be sufficiently above that in the pump to lift the foot valves, overcome the inertia of the water and drive it up through the valves into the barrel. The higher the speed of this type of pump the less the time between strokes and the greater the pressure required for



AIR PUMP WITHOUT FOOT VALVES.

operation; and as any increase in pressure in the condenser is accompanied by a corresponding increase of back pressure in the l. p. cylinder of the engine, it follows that any increase of speed of an air pump fitted with foot and bucket valves means loss of efficiency. Also with the old type, running at high speeds the discharge is apt to be very intermittent. It frequently happens that for several revolutions, while the pressure in the condenser is accumulating, no water is delivered; but when the pressure is sufficient to open the foot valves and drive the water into the cylinder, the pump has suddenly to deal with far more than its normal quantity of water, thus causing a series of violent shocks which often cause serious breakdowns.

In the old type of air pump the water has received first consideration and the air practically none. In the Edwards Air Pump the conditions are reversed. The question of satisfactorily dealing with the air so that no back pressure is produced in the condenser or l. p. cylinder has been considered of primary importance. Then the water has been dealt with in a most satisfactory, theoretical and practical manner.

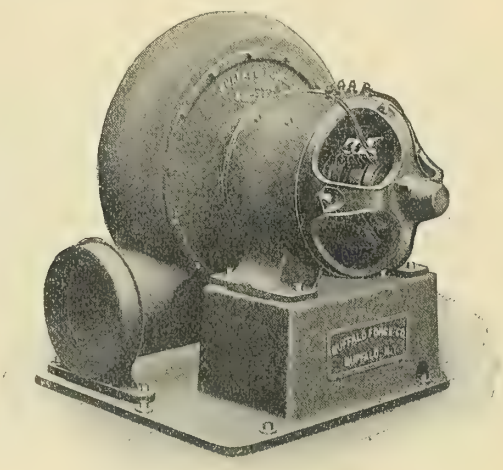
The mechanical features have been reduced to the utmost simplicity. There is but one set of valves placed on the outside of the cylinder, where they can be examined while the pump is in operation by opening the doors. The weir shown on top of the pump permits this examination without loss of fresh water, even in a heavy sea. Thus a thorough examination of all the valves is provided for without stopping the pump. The valve seats are each provided with a lip extending around the outer edge, so that each valve stands in its own water and is separate from the others. This forms a ready means of testing the relative tightness of each valve. The top clearance is reduced to a minimum, thereby considerably increasing the efficiency.

These pumps are arranged either single, double or three-throw; steam, electric, belt driven, or by levers from the main engine; slow speed or high speed, for use in connection with both surface and jet condensers.

The Wheeler Condenser and Engineering Company, of 120 Liberty street, New York, is the manufacturer and licensee for the United States of the Edwards Patent Air Pump, with full rights to grant licenses to others to build these pumps on a royalty basis.

Direct Connected Electric Exhauster.

The accompanying illustration shows one of the many interesting adaptations of electric apparatus so common in these days. It consists of a centrifugal fan or exhaust blower driven by a direct connected motor, for which service, by reason of the identity of motion of the driving and driven elements of the combination, the electric motor is peculiarly adapted. The constant resistance to the rotation of the fan wheel is overcome by a constant torque acting on the armature of the motor.



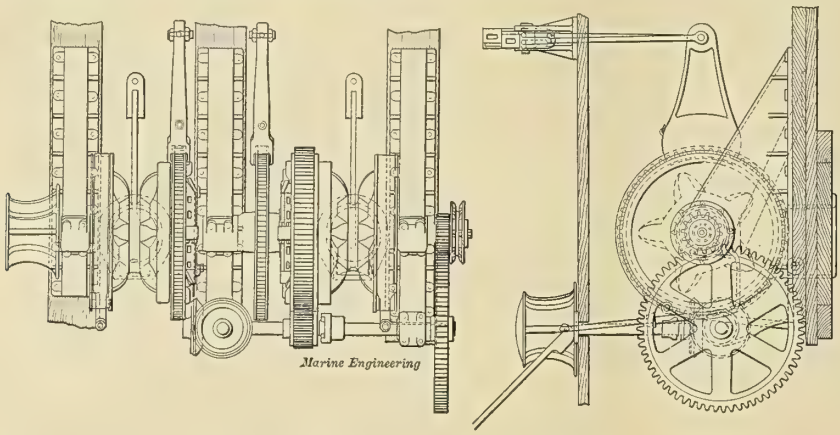
ELECTRIC DRIVEN EXHAUST BLOWER

The fan may be designated as a right-hand bottom, horizontal discharge exhaster, and is composed of a rotating blast wheel and a stationary casing. This casing consists of a circular discharge mouth piece cast with the circumferential rim, to which are bolted the two side plates. In the plate nearer the motor is provided the opening for the motor shaft, while in the other is located the circular air inlet. A distinction is usually made between blowers and exhausters, the lat-

ter having but one inlet, and the former having one on either side.

The blast wheel is built up of steel plate blades with backwardly curved tips, bolted to spider arms carried on a cast iron hub. The dimensions of these blades, as well as of the inlet and discharge openings, have been proportioned after careful experimenting, so as to afford maximum efficiency. The air enters the fan in a direction parallel to the shaft, passes outward along the blades with an increasing acceleration due to the centrifugal force, and is discharged radially from the tips with a velocity substantially equal to the peripheral velocity of the wheel. The pressure developed by a given fan varies as the square of the velocity, while the power expended varies as the cube thereof. The volume delivered is approximately proportional to the number of revolutions. Hence the loss entailed by using too small a fan and speeding it up to secure a given output is obvious.

The motive power of the fan shown herewith is a Lundell motor, manufactured by the Sprague Electric Company, and is of the enclosed type. A cast iron base supports the motor at the proper height. The fan itself is a product of the works of the Buffalo Forge Company, of Buffalo, N. Y., and it will be understood that the details of construction may be such as to allow the attachment of any standard motor. These fans are constructed in sizes up to No. 11 B, which requires 50 horse power, when developing 6 ounces pressure at 1,100 revolutions per minute.



A BRAKE WINDLASS USED ON LARGE SCHOONERS.

The Hyde Brake Windlass.

The cut on this page shows a plan and elevation of the Hyde brake windlass fitted on board the six masted schooners *Eleanor A. Percy* and *Geo. W. Wells*. The windlass is located on the main deck underneath the forecastle deck and is driven by 3-4-inch messenger chain from the 9 by 10 inch hoisting engine, located in the forward house. The chain pinion is shown on the starboard end of the windlass shaft. To this chain pinion is keyed a spur pinion driving a spur pinion free to turn, so arranged as to lock to the shaft by means of a clutch, as shown, and drive a spur gear keyed to windlass shaft. The windlass may be worked by hand power from the forecastle deck through pump brakes and levers. A gypsy end is keyed to the port end of windlass shaft for warping purposes or handling heavy loads. There is also a warping head of 20 inches diameter on the forecastle deck driven by bevel gearing from the countershaft of the windlass, and making about 10 revolutions per minute with the hoisting engine running at 250 revolutions per minute, while the gypsy head on the windlass shaft would turn about 2 1-2 revolutions per minute.

The windlass proper is mounted on three cast-iron bitts, as shown. The center and starboard bitts have a counterbearing cast on the after end for carrying the countershaft. This countershaft is 4 3-4 inches diameter, and the windlass shaft is 7 inches diameter. The bearings for both these shafts are lined with white brass. The bitts have wide flanges on the bottom and are provided with a suitable number of holes for bolting securely to the sills. Friction bands are fitted to each wildcat of ample strength and sufficient surface to ride by with the windlass unlocked. The friction bands operate from the forecastle deck by compressors, as shown. The wildcats are fitted for 2 3-4-inch stud link chain, and are locked to the shaft by means of a positive locking device worked by raised cams on the periphery of a locking ring and slotted block keys seated by a lever. Clutches are fitted to the upright shaft and countershaft, sliding on feather keys. By means of these clutches the warping head on the forecastle deck can be worked independent of the windlass, and also the windlass can be disconnected from the engine and operated by hand power. A chain clearer is fitted to each wildcat for stripping the chain in case it should become wedged in the wildcat.

These windlasses were built by the Hyde Windlass Company, and are the largest of this type ever built for a sailing vessel in this country.

Device for Launching Life-Boats.

The well known inefficiency of the present mechanism for handling and launching life-boats from ocean going steamers, and the loss of life resultant therefrom, has given rise to considerable thought on the part of many interested in the problem. The device as illustrated and described in the following article is claimed by the inventor to be, at least, a step forward in the proper direction.

The accompanying photographs of the model Nos. 1,

2, 3 and 4 represent the gear mounted and housed on the sun deck of a steamer, lifting cranes raised ready to lift life-boat from chocks, boat being swung over the side of the ship, and finally boat clear of ship being lowered to the water. The main points of advantage over the old gear claimed for this arrangement are first, the providing of a more perfect means to get the boats into the water quickly in case of accident; second, the

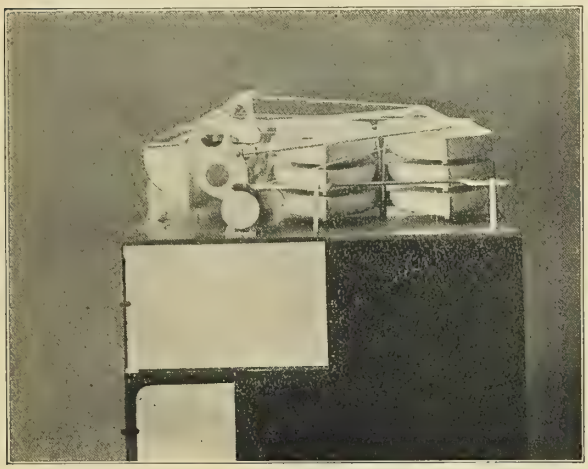


FIG. 1.

assurance that both ends of the boat shall be lowered equally; and third, the providing of means for quickly detaching the boat when in the water. A further object

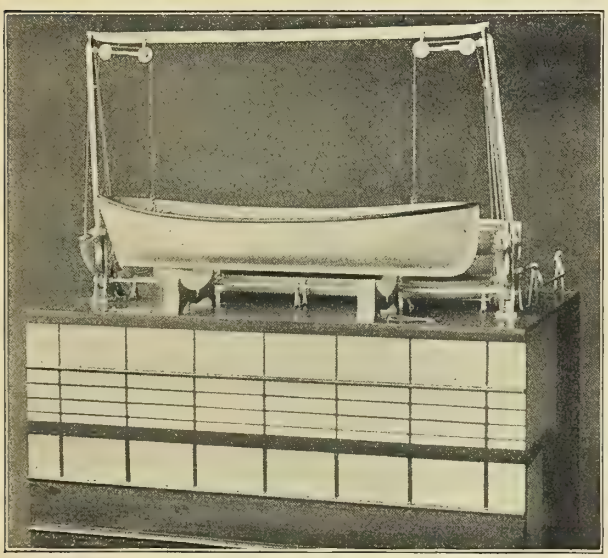


FIG. 2.

is to provide a launching device by means of which several boats may be launched from the same point and with people in the boats. These objects are attained by the following mechanism:

Two standards or brackets are fastened on the deck of the ship, and on the top of each on a short shaft a toothed quadrant or segmental gear is mounted, each supporting a derrick, in whose outer ends a beam is trunnioned, which with the stays of the derrick serves to steady the same and makes a very stable crane, the parts being proportioned in size and so disposed that a life-boat may pass freely between the derricks in the act of being launched. Through the lower parts of the standards another long shaft, running from one stand-

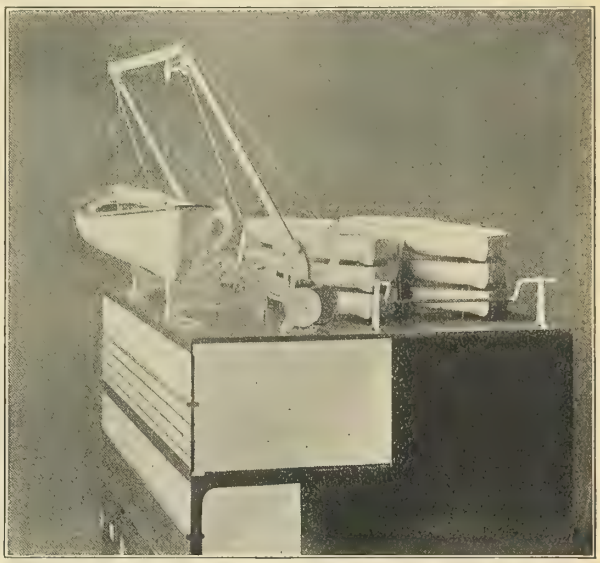


FIG. 3.

ard to the other, is passed, having two pinions mounted on it in mesh with the quadrants, and at one end of the shaft, outside of the bracket, another gear operated by a worm, which is in turn operated by a suitably sup-

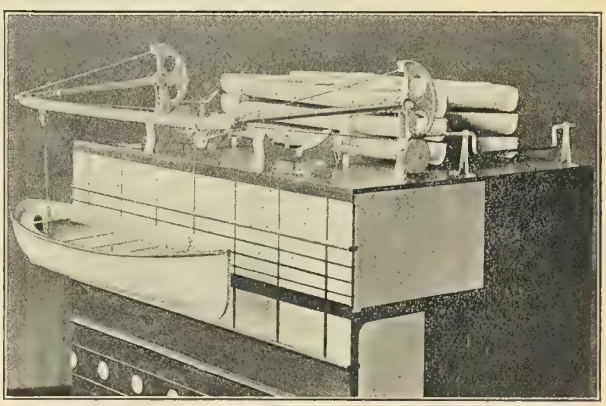


FIG. 4.

ported crank. As the pinions in mesh with the quadrants are secured to the shaft, the derricks will be operated in unison by turning the crank, and as the beam connecting the outer ends of the derricks is free to rotate, it will always maintain a vertical position. In the rear of the above mentioned shaft, another shaft, also having its bearings in the brackets and rotated by a similar arrangement of worm and wheel mounted on the opposite side of the one mentioned previously, is provided. On this shaft, at opposite ends, two drums

are mounted on which run the ropes leading to the detaching gear. It is therefore evident that by reason of the above mentioned construction both the crane and lowering device may be operated simultaneously so that when the life-boat is swung over the side of the vessel the boat can be lowered by continuing to operate the crane and lowering device, thus greatly expediting the launching of the life-boat, or vice versa. In order to keep the lowering ropes from being fouled by the life-boat in passing between the derrick, they are led through a series of ingeniously arranged pulleys attached to the brackets and cranes, as shown in the photographs. It will be easily understood that this arrangement permits the launching of a life-boat from the high side of a vessel having considerable list; in the case represented by the model this list amounts to about 20 degrees, depending, of course, on the length of the cranes, which again is limited by the weight of material permissible in the construction. This launching of a boat from the high side of a steamer is not possible by means of the present davits.

The detaching gear mounted in each life-boat consists of a series of rods, levers and links, so arranged that they are in absolute control of the officer of the boat, and in his control only. The attaching and detaching of the rings affixed to the ends of the ropes, doing away with the dangerous blocks, can only be done simultaneously, thus avoiding the oft recurring danger resulting from the release of only one end of the boat. Due to the weight of the boat on the detaching gear it is impossible to release the same before it is water-born, thus avoiding the great danger of premature release.

A diploma of honorable mention was awarded Wm. J. Kennedy, the inventor of the device, by the International Jury of Awards at Paris, where a model of the year was exhibited in competition for the Anthony Pollock prize. Mr. Kennedy's address is Pier 14, North River, New York City.

The Marine Cableway for Coaling Ship on the U. S. S. Illinois.

The first marine cableways for coaling ship were placed upon the collier rather than upon the ship to be coaled. The success of this method installed on the Lidgerwood-Miller system is well known, and in the most recent trials it has shown a capacity of 35 to 40 tons per hour, with the battleship towing the collier at a speed of 8 to 11 knots. The first warship to be equipped with a similar cableway is the U. S. S. *Illinois*. The chief advantage of this system is that it will permit the battleship to take coal at sea from any masted vessel which it may meet in any quarter of the globe. The equipment requires two special winches, Fig. 1, which have been so designed as to serve a special purpose. The winches originally located on the superstructure deck of the *Illinois* have been displaced by these two special winches, which serve all general purposes of the original machines, and in addition are adapted for operating the marine cableway when coaling at sea. In this manner there has been no essential increase to the machinery of the warship and no additional deck space has been required. The only additional equipment on deck consists of a few deck bolts, a coil spring at the masthead, and two levers conveniently located on the after bridge. Just below the steering compartment and beneath the platform deck the remainder of the equipment is located. A reel suspended from the deck carries 2,000 feet of 7-8 inch sea anchor line. There are also two 3-8-inch conveyor lines and two sea anchors. There are also the haul-down block, carriage blocks, etc., all of which occupy a space just below the deck, 16 feet long, 7 feet wide and 4 1-2 feet deep. The coil spring attached to the mainmast will be completely compressed under a load of 20,000 pounds, but a strain of 12,000 pounds only is developed in carrying a load of one ton. As the warship pitches and ascends, this spring will compress and elongate, thus serving to equalize the somewhat varying strain on the sea anchor. The arrangement of the blocks

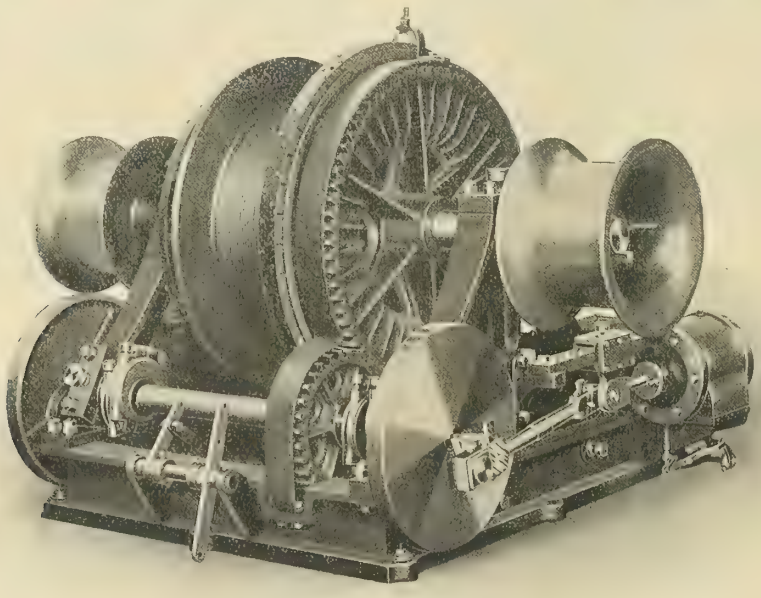


FIG. 1—SLIPPING DRUM WINCH ON U. S. S. ILLINOIS SERVING FOR BOTH COALING AT SEA AND BROADSIDE IN HARBOR.

and lines is shown in the accompanying figure. After the sea anchor has been located and the sea anchor line made taut, the tail block, shown in Fig. 2, is hauled over and attached to the mast of the collier. This carries with it the conveyor line from one of the winches. At a point above the sea anchor line another lashing is

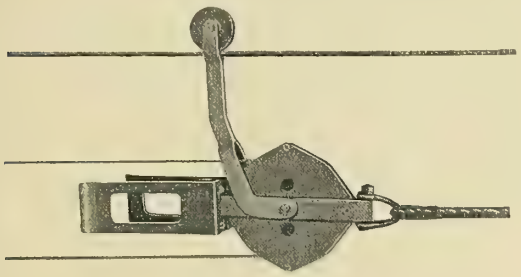


FIG. 2.—TAIL BLOCK.

made and two 3-4 inch wire guy ropes are there attached and led forward on an incline to the starboard and port sides of the ship, where they may be attached to the

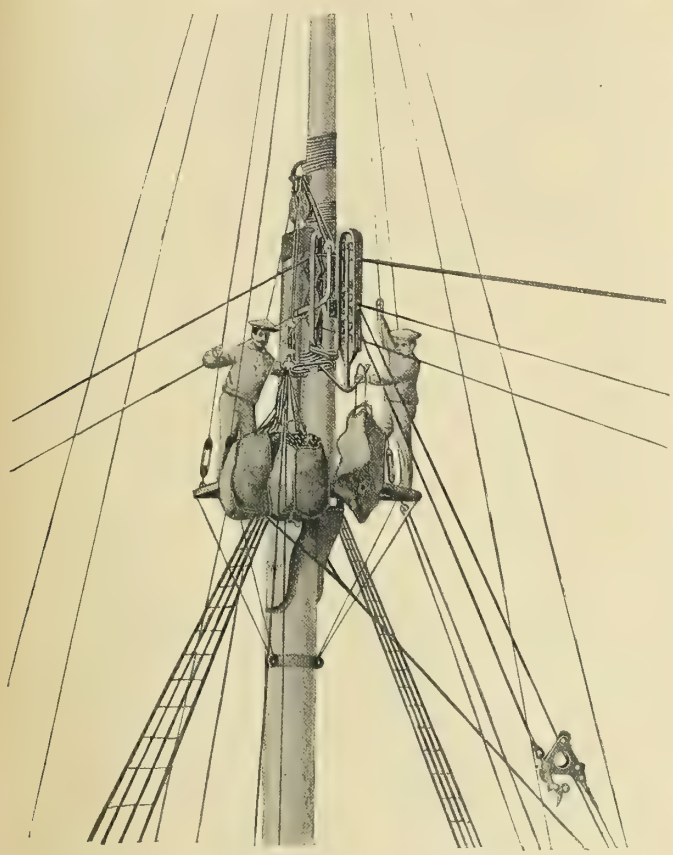


FIG. 3.—TRANSFERRING LOAD AT COLLIER MASTHEAD.

deck at almost any place found convenient. On these two inclined stays will run the two little elevating trucks, weighing only 37 pounds each, as shown in Fig. 4. Loads of one ton can be hoisted from the port deck and then the starboard deck, in alternation, to the masthead, where two men are located, as shown in Fig. 3. One of these men takes in his hand the loose ring which is a part of the elevating hook. When the cableway carriage (Fig. 5) reaches the collier's masthead the ring is placed by hand over the hook of the carriage, a lever is pulled on the elevating truck, and the load is dropped and thus transferred to the cableway carriage. This operation, by actual time, has been accomplished in two seconds. The other man at the masthead will take off the empty bags as they return from the warship and send them to the deck for refilling.

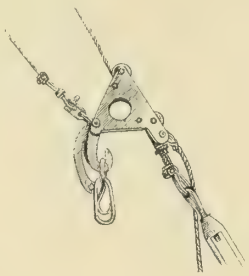


FIG. 4.—ELEVATING TRUCK.

With the present arrangement the load starts out from the collier on a down hill route and continues so for more than half the distance. When the load is just clear of the center of the span and in its lowest position the man on the warship commences to pull down the

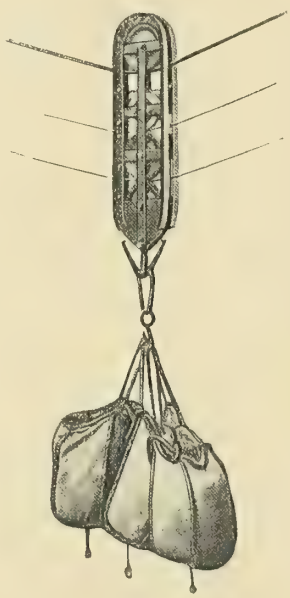


FIG. 5.—LOAD CARRIAGE.

haul-down block, and by the time the bags reach this block they will be trailing on the deck. The operator then stops for an instant, lowering continues for a foot or more, the load is unhooked from the carriage, the empty bags put on and the whole lifted to its normal position. At the same time the operator sends the empty carriage back to the collier for another load. The capacity of this equipment should be 60 round trips per hour, and the quantity delivered should not be less than 40 tons in the same time. The chief limiting factor in

the capacity will be the ability of the men on the collier to feed the cableway.

By having our warships thus equipped the question of coal supply is largely solved, and solved with less cost than in any other way, since they can coal direct from any collier and are not dependent upon coaling stations.

Our navy needs a few colliers in peace times, and a great many in case of war. Any masted ship, either sailing vessel or steamship, can do duty as a collier and deliver its coal at sea to any warship equipped with a Marine Cableway. All colliers should also be fitted with Marine Cableways when time permits. Such colliers, however, should be fitted to deliver coal to the smaller warships in tow of the collier. Even a destroyer could be coaled at sea by a collier properly equipped.

The Marine Cableway thus installed is intended to permit a fighting vessel to remain in the fighting line. It is intended to permit a fleet of war vessels to arrive off the coast of the enemy with their bunkers full instead of empty. Another phase of the question relates to the possibility of the United States becoming involved in war with a foreign power. In such case the merchant ships and coal carriers would probably fear to leave the home ports because of their liability to capture, and it is probable that the government would have offered to it an abundance of such vessels as coal carriers, at favorable prices, whether for purchase or for charter.

Converting Ships for the Oil Trade.—Many of the shipyards of the Atlantic and Pacific coasts are busy transforming steel ships into oil transports.

Trial of the Truxton.—The torpedo boat *Truxton,* nearing completion at Sparrow's Point, Md., was given a builder's trial recently in Chesapeake Bay at which a speed of 27.75 knots was attained.

Shipbuilders Busy.—The shipbuilders of New England and of the maritime provinces are enjoying a period of great activity this year following upon the successful business in 1901. There are building or under contract in these sections 182 merchant vessels of over 100,000 tons.

Ten Months' Shipbuilding Returns.—The Bureau of Navigation reports 1,072 sail and steam vessels, of 329,499 gross tons, built in the United States and officially numbered during the ten months ended April 30, 1902. During the coresponding ten months ended April 30. 1901, 881 sail and steam vessels of 310,132 gross tons were built in the United States and officially numbered.

A New Magazine.—A new magazine, called the *Maritime World,* has been started in San Francisco. This publication contains many interesting items under the heading of the Month's Log Book, and the leading articles of the month cover the topics of present interest in the maritime field and treat of such subjects as the Ship Subsidy bill, the new turbine steamer, lake and ocean traffic, etc. Several pages are devoted to commercial and marine notes, and news concerning the New World Markets. Under Flotsam and Jetsam are given items of interest to shipbuilders. The *Maritime World* is well printed on good paper and the 36 pages of reading matter are a credit to the publishers, the Maritime World Company, 22 Clay street, San Francisco, Cal. The price per year is $3, and per copy 35 cents.

THE PROFESSOR ON SHIPBOARD.

Story of an Attempt to Combine Theory With Practice.

BY C. A. MC ALLISTER, FIRST ASSISTANT ENGINEER, R.C.S.

CHAPTER X.

On the following day the Professor spent the greater part of the morning lolling about under the awnings and in reading. The fact of the matter was that the prevailing temperature was having its effect on him, and he had reached that stage where he was losing his ambition to keep employed at something useful. At about ten o'clock he joined the 1st Officer on the bridge, and watched him taking a sight with the sextant, or "shooting the sun," as the officer expressed it. Although the Professor had never actually taken a sight he was more or less familiar with the theory of navigation and very readily followed the officer's calculations for a time sight. The air of mystery and superiority which the deck officer assumed during this operation was very amusing to the college man, for the calculations were so simplified by reference tables that anyone with even a rudimentary knowledge of trigonometry could easily learn as much navigation as the deck officer possessed, in a very few lessons. In fact he quite astonished the navigator by pointing out to him several methods of shortening his calculations, which he reluctantly acknowledged were improvements. The Chief Engineer, who happened along at that time, seemed also somewhat agreeably surprised that his younger brother possessed so much knowledge of a subject in which he himself was entirely lacking, although he had spent many years at sea.

The Professor explained to him that any man educated in a technical school could easily grasp such subjects, as his mathematical training fitted him for just such work. To this the Chief replied that a technical education was undoubtedly a good thing to have, but how, said he, can a young man who has to hustle for a living from the time he is fourteen years old, ever expect to get a college education? The Professor remarked that he was glad to have that subject brought up, and went on to state that to obtain an education in the engineering profession it was not absolutely necessary to attend a college.

"It does not make a particle of difference whether a young man is a graduate of a technical school or not; it is what he can do that determines his standing and fixes his salary. There are just as competent men in the profession to-day who obtained their education by their own efforts, as there are who have graduated from colleges. Of course, everything else being equal," he continued, "the college man has the advantage at the start, but in actual work the man who uses his brains and skill to the best advantage in his employer's interest, will eventually go to the front whether he is a graduate or not. In this connection the Chief asked his brother what his opinion was of the various correspondence schools which are now so extensively advertised. To this interrogatory the Professor replied that he considered them as excellent institutions.

"Why," said he, "one of my colleagues at the university where I am employed originated the correspondence instruction idea, and I am very much pleased

to see how successful it has proven to be. In this way hundreds of young men are being greatly aided in their efforts to obtain an education. As the attainment of that end is entirely due to a man's own efforts, there seems to me to be no reason why any young man, and especially oilers and junior engineers on board ship who are ambitious to succeed in their profession, should not be greatly helped by joining one of these schools. Of course," said he, "I am a firm believer that young men with the necessary means should attend technical schools, but if they are not able to do so, the next best procedure is to get as much help as they can in this modern method. They can then earn their own living, and spend part of their spare time in studying. I understand," he continued, "that there are numerous cases where young engineers have been materially advanced in their business through the help of a course of studies as mapped out by some of these correspondence schools."

After luncheon that day the college man stretched himself out in an easy chair and, like a good many of the passengers, he enjoyed a siesta. When he awoke he was approached by the 1st Assistant, who remarked that he was glad to see him enjoying himself.

"Yes, I am getting quite lazy," said the Professor, "and if the engineer's crew all felt as I do I am afraid that the ship would come to a standstill until all hands had taken a nap."

The Assistant reminded him of his promise to explain something more about indicator cards.

"Oh, yes, so I did," said the man of figures. "If you will get me those cards I took last evening and a scribbling pad I will see what I can do with the subject."

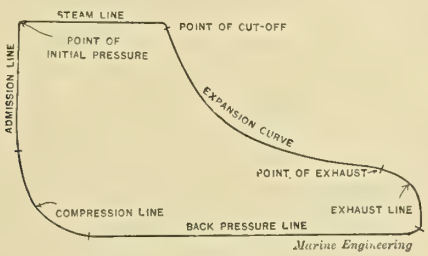


FIG. 1.

The Assistant promptly went down in the engine room, and after obtaining the desired articles, brought them up on deck. He was soon joined by the Chief, who remarked that as he was a little shy on the subject he would like to hear what his brother had to say.

Taking up the subject the Professor stated that he supposed they were quite familiar with indicator cards, and apologized in advance if he should attempt to explain anything which they already knew.

"Now that we have taken a set of cards from the high pressure cylinder, it would, of course, be well if we had several sets from each of the other cylinders, but for purposes of illustration the high pressure cards will do very well. As you probably know, an ideal card should look something like this: (See Fig 1.)

"On this card I will mark the names of the different lines and points, which it is always well to remember when discussing this subject. As you can easily see, the actual cards which we took last evening differ considerably from the card which I have sketched, due to many causes. For instance, on the ideal card the admission line is shown very nearly perpendicular, and, in fact, it should be exactly so. If it inclined inward, and the indicator was correctly adjusted, you could feel positive that the valve was so set that the steam was admitted too late. If, on the other hand, the admission line was inclined outward, the valve would evidently be admitting the steam too soon.

"The greatest discrepancy is liable to exist in the expansion curve. This curve follows nearly the shape of a hyperbola. It is often found, however, that the terminal pressure at the end of this curve is higher than it would be with the usual law of expansion. This is largely due to the fact that almost all steam valves leak steam into the cylinder after the point of cut-off has been reached.

"Sometimes, too, it will be found that the curve runs lower than might be expected. This state of affairs is due generally to the fact that the engine piston and the exhaust valve leak. At times cards are obtained wherein this curve is apparently correct, but it is not always safe to assume that because of that effect the valves and piston are tight, as the leakage through both may be just sufficient to compensate each other. You may have observed that the expansion curve is sometimes wavy; this condition is generally caused by water in the indicator cylinder, or to an excessive amount of vibration of the instrument. There are numerous other defects that I might point out to you in connection with indicator cards, but in general it should be the aim in designing an engine, and in adjusting the valve gear, etc., to give a card with the following general features:

"1. The steam line should be as nearly paralled to the atmospheric line as possible, and it should be nearly as high as the line drawn to the scale and representing the pressure in the boiler. This result shows that the steam pipe is sufficiently large; that there is no undue friction in the stop and throttle valves and main steam pipe; also that the steam ports and valve openings are of sufficient size.

"2. The expansion curve should be nearly hyperbolic, showing generally that the valves and piston are tight.

"3. The admission line should be nearly perpendicular to the atmospheric line, showing that the steam is admitted to the cylinder at exactly the right time.

"4. The back pressure line should be parallel to the atmospheric line, showing that there is a sufficient opening of the exhaust valve.

"5. The point of cut-off, point of exhaust opening and point of exhaust closing should theoretically be clearly defined, but in practice, owing to the gradual opening or closing of a slide valve, they are generally represented by curved lines."

At the conclusion of this part of the Professor's dissertation he looked up and somewhat to his chagrin saw the Chief with his eyes closed and slightly nodding his head. Upon being accused of sleeping, he quite indignantly denied the charge and said that he was simply trying to memorize what the Professor was

saying. Considering the closeness of the afternoon the Professor felt inclined to doubt his brother's assertion.

"I wouldn't blame you much if you were asleep," he continued, "as this is a somewhat dry subject. Now if you will keep your eyes open for a few moments I will try to show you something about working up cards to determine the power developed by an engine. The first thing I want to impress on you is to clearly understand the term 'power'. Many people use the terms 'work' and 'power' as synonymous. As a matter of fact they do not have the same meaning at all. For instance, if you carry a weight of 10 lbs. up a flight of stairs 20 feet high you have performed work to the amount of 200 foot pounds. That is, work consists of two elements only—force and distance.

"To determine the 'power' you used in carrying up that weight you must take into consideration the time you spent in going up the stairs. That is, power consists of three elements—force, distance and time. In the early days of the steam engine, it was of course found necessary to establish a method of stateing the power developed. The horse being one of the most useful and universal beasts of burden, the engineers of that day naturally based their comparisons of the power of engines on that of horses. Accordingly a series of experiments were made with some powerful London dray horses, and it was determined that the average power of these horses was equivalent to lifting 1,000 pounds through a height of 33 feet in 1 minute, or 33,000 foot-pounds per minute.

"This was then adopted as the unit of power for the steam engine. It may interest you to know, however, that the average horse cannot raise a weight of 1,000 pounds a distance of more than 27 feet in a minute. That is, they can only develop a little over 80 per cent. of the so-called horse power. Now then, to find the power developed by an engine, we must determine just three elements. The time and distance are easily ascertained by noting the number of revolutions made by the engine in one minute. The actual distance traveled by the piston is of course equal to twice the number of revolutions, as it goes up and down in one turn of the engine. Thus your engine here has a stroke of 36 inches, and is now making about 110 revolutions per minute.

"Remembering that the distance must be expressed in feet, you see that the piston travels 3 feet down and 3 feet up, or 6 feet in one revolution and 660 feet in one minute at the speed of 110 revolutions. This 660 feet is known as the 'piston speed,' and, by the way, that is rather slow for a modern engine, as nowadays a piston speed of 900 to 1,000 feet ought to be obtained on all first-class passenger vessels.

"The other element, 'force,' is somewhat more difficult to determine, and here is where we use the indicator card. As you know, the spring of an indicator is so proportioned that the height of the steam line and the expansion curve show at any point the pressure of the steam on the piston, when measured by a scale proportioned to the spring. As this varies at nearly every point on these lines it is necessary to obtain the average height and consequently the average pressure on the piston during the entire stroke. There are several methods for ascertaining this average height. The best method is by the use of an instrument known as a planimeter. This is an instrument such that by running a pointer all around the card the exact area inclosed can be read from a cylindrical scale, with a vernier attachment. It is usual to take the average of two or three readings of this scale in order to minimize the chance of error. Knowing the area of the irregular figure, and the length, the average height is readily determined by dividing the area by the length. If you do not happen to have one of these instruments the average height may be approximately determined by the following method: Divide the diagram, as shown in Fig. 2, into any number of equal parts, say ten for convenience, by drawing lines perpendicular to the atmospheric line. Then subdivide each one of these parts into two equal parts, as shown by the dotted lines. Measure each dotted line with a scale graduated to correspond to the spring used in the indicator. Add together the lengths of these dotted lines and divide by 10, and the quotient will be the average height, or the mean effective pressure.

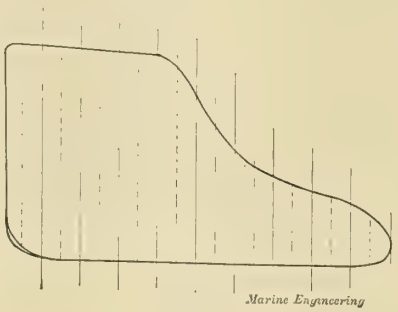


FIG. 2.

"A convenient method of measuring these lengths is to take a strip of paper and mark off on its edge each length, one following the other. The sum of all the lengths or ordinates, as they are called, can therefore be determined by simply measuring the distance between the extreme points with the scale used. Knowing the average pressure exerted on the piston during its entire stroke, it is only necessary to multiply it by the area of the piston expressed in square inches to determine the third element of 'force' for the calculation of the power.

"In estimating the power, you must not lose sight of the fact that as the piston rod comes through the bottom of the piston, an allowance must be made for its area. Thus the high pressure cylinder of this engine is 30 inches in diameter, and the piston rod is 5 inches in diameter. The area of 30 inches diameter is 706.86 square inches. This area is correct for calculating the power during the down stroke; but on the up stroke the rod must be taken into account. Thus the area of a 5-inch circle is 19.63 square inches and 706.86 — 19.63 = 687.23, the area to be used for calculating the power developed on the up stroke. It is usual as a matter of convenience to take half the area of the rod from the total area of the cylinder, and to use this area for cal-

culating the power developed in one revolution, or two strokes. Thus ½ of 19.63 = 9.86 and 706.86 — 9.86 = 697.00 square inches in the area to be used.

"The old formula of P. L. A. N. ÷ 33,000 is very convenient to memorize, but it is too often used without knowing its meaning, and I hope that I have made it clear to you. Thus you will see that the factors P and A are necessary for determining the element force; N and L determine the elements of time and distance. I know that I have gone over a great deal of matter that is already familiar to you, but it won't do any harm for you to review it, and I hope that I have brought out some new ideas of the subject for you."

The Chief Engineer, who had kept awake during the latter part of his brother's talk, thanked him for what he had explained to them, and said that he had been much interested. The 1st Assistant said the same thing, so the Professor did not think that his time had been entirely wasted, although he felt doubtful as to whether he had imparted any new information to his listeners.

TECHNICAL PUBLICATIONS.

Easy Lessons in Mechanical Drawing and Machine Design, arranged for self-instruction by J. G. A. Meyer and Charles G. Peker. Two volumes. Size 9½ by 13 inches, pages 680, with upwards of 750 illustrations and several full-page plates. New York, Industrial Publication Company. Price $11.50.

Volume I of this large work, together with about three-fourths of Volume II, had been completed by the author at the time of his death in 1900. In accordance with the wish of the author the work as a whole was carried forward to completion by the assistant author who had been associated with him in the work and who therefore had full access to the author's manuscripts, drawings, etc., and who was furthermore thoroughly conversant with the character and purpose of the work as it lay in the author's mind. The two volumes are therefore to be taken together as a single work intended to give instruction in Mechanical Drawing as applied to Machine Design, together with information regarding the field of Machine Design in itself. The purpose of the author was furthermore to so present this matter that it should constitute a self-instruction book and serve therefore the needs of those desiring to advance themselves in the knowledge of drafting and design, but unable to obtain the advantages of regular instruction in these branches.

The work as a whole is divided into sixteen chapters. The earlier chapters relate naturally to the geometrical principles involved, which are illustrated by many practical examples. The description of ordinary drafting instruments, together with methods of their use, also find treatment in this part of the work. In the later chapters applications of Descriptive Geometry to drawing are given, together with special discussions of points relating to Mechanics as applied to Machine Design. A large amount of information in the form of rules and empirical formulæ for design is also given, but without that relation to their rational basis in Mechanics which would be desirable in a book of design. Distributed throughout the work are numerous examples of machine drawing and design, illustrated by various machine tools, parts of steam engines, pulleys, gearing, etc. These drawings are well executed and well reproduced, and form perhaps the most satisfactory part of the book.

The feature of the work as a whole which seems to call for some criticism is that of the arrangement and mode of presentation of the subject matter. Examples of advanced machine design are distributed throughout the work without regard to their relative difficulty or to the principles of design which are involved. Thus complete drawings of a 16-inch engine lathe are presented and discussed to some extent in the first chapter of the work, and in advance of any consideration of drawing instruments or their use, or the elements of geometrical and mechanical drawing. Similarly with regard to the rules and methods of design, they are distributed throughout the work without logical arrangement, and any given item can only be discovered by reference to the index at the end of the work.

With a somewhat more logical and orderly presentation of the subject matter of this work we believe that it is one which would be found of great value for that class of draftsmen and designers for which it was especially intended.

The Indicator Handbook, a practical manual for engineers. Part II. By Charles N. Pickworth. Size 4½ by 7¼ inches, 132 pages with 148 figures in the text. New York, D. Van Nostrand Co. Price $1.50.

This volume is Part II of the work published by the author under the above general heading. In Part I the construction and application of the indicator were dealt with in detail, and the subject was taken up chiefly from the standpoint of what might be called indicator practice. The present volume is intended to complete the work as a whole, and is devoted to the analysis of the indicator diagram and to the various computations based upon it.

The work is divided into seven chapters with an appendix. The first chapter gives a general discussion of the preliminary considerations and definitions bearing upon the problems which are to be studied. In chapter two the diagram is discussed in detail, and special attention is given to various modifying and disturbing influences and their results upon the diagram. In chapter three the analysis of the diagram is undertaken, special note is given to its application to the usual problems of valve setting with the interpretation of unusual types of diagrams. Chapter four deals with diagrams from compound engines and their combination and interpretation. In chapter five diagrams from gas and oil engines are considered with the same general detail and care as with steam diagrams in the preceding chapters. Chapter six deals in a similar manner with diagrams from air and ammonia compressors, pumps, etc. In chapter seven the usual calculations for mean effective pressure and indicated horse power are discussed. The use of the planimeter in its various forms is also described, and a clear presentation is given of the principles bearing upon these calculations.

Taken as a whole the book forms a valuable supplement to Part I, and the two together provide an excellent guide to the manipulation and application of the instrument, and also to the intelligent interpretation and use of the diagrams which it is intended to furnish. These features are sure to make the book of high value to the

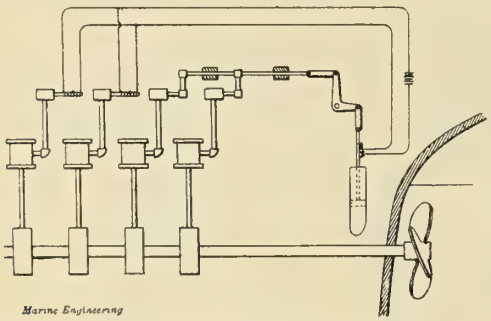
practical engineer, and it may be confidently recommended to all such as a convenient and instructive handbook regarding this field of engineering practice.

SELECTED MARINE PATENTS.

696,972. SUBMARINE BOAT. JOHN P. HOLLAND, NEWARK, N. J.

696,982. TIDE-MOTOR. FRANK H. LAUTEN, BROOKLYN, N. Y.

697,053. BRAKE FOR PROPELLER-SHAFTS. GEORGE WHITTLESEY, NEW LONDON, CONN.



CLAIM.—1. In a device for preventing racing of marine engines, a float subjected to variation in water-pressure near the propeller, valves controlled by said float governing means for applying a resistance to the rotation of the propeller.

CLAIM.—8. A governor for a marine engine comprising a brake mechanism for the propeller-shaft, said brake being actuated by a fluid-pressure, said pressure being in turn governed by a float, the fluid-pressure being independent of the power of the float. Ten claims.

697,202. MECHANISM FOR TRANSFERRING BOATS. LEON DONNE, CHICAGO, ILL.

CLAIM.—1. As a means for moving boats from one level to another the combination of two shafts provided with wheels, one of said shafts being located below the level from which the boat is to be moved, and the other shaft at a higher level, an endless belt or apron provided, arranged around the wheels on said shafts and provided with supports for the boat, and means for preventing a sagging of the carrying portion of the endless belt or chain. Four claims.

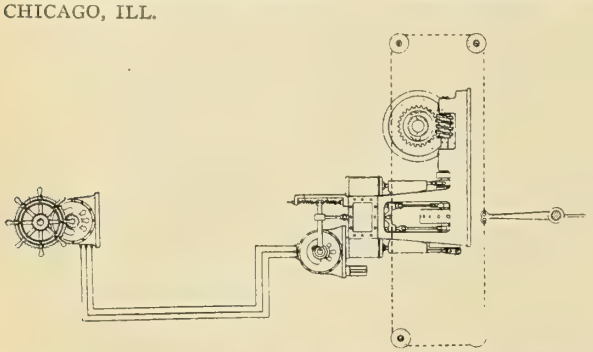
697,359. APPARATUS FOR LAUNCHING LIFE-BOATS FROM SHIPS. CHRISTIAN F. PETERSEN, WILMINGTON, DEL.

CLAIM.—1. In boat-launching apparatus, the combination of a permanent overhead track with support, a swinging continuation of same with stay and guys, a truck as a means of transporting boats from the permanent track to the end of the swinging track. Five claims.

697,539. BOAT. CHARLES S. PRUDEN, ROME, GA.

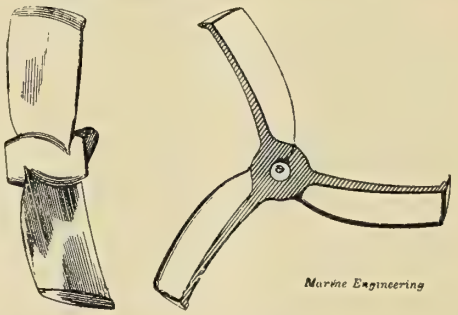
697,712. PADDLE-WHEEL. HENRI GLARDON, GALVESTON, TEX.

697,826. ELECTRICAL STEERING APPARATUS FOR SHIPS. BRADLEY A. FISKE, U. S. NAVY, ASSIGNOR TO WESTERN ELECTRIC COMPANY, A CORPORATION OF CHICAGO, ILL.



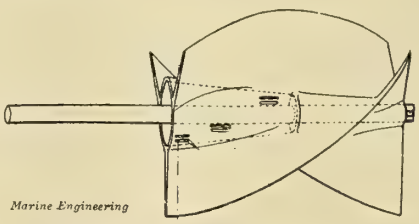
CLAIM.—1. In an electrically-controlled steering apparatus, the combination with a helm of an electric motor device and mechanism associated therewith for moving the helm, a hand steering-wheel, and a generator of electricity having an armature or rotor adapted to be turned by said steering wheel and connected with the motor device, whereby the helm may be controlled by moving said steering-wheel, substantially as set fortn. Five claims.

698,582. PROPELLER-WHEEL. EDWARD E. STROTHMAN, WEST SUPERIOR, WIS.



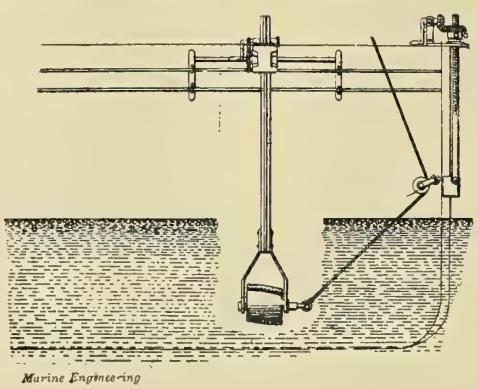
CLAIM.—1. A propeller-wheel, comprising a hub, blades radiating therefrom and each set upon an angle with relation to the longitudinal axis of the hub, each of the blades gradually increasing in width from its line of jointure with said hub for a comparatively short distance, and from thence to the outer end being substantially of uniform width and curving laterally rearwardly and having its front face convex, the rear face of the blade being substantially flat, and the blade being comparatively thick near its base and tapering to its outer end, substantially as described. Four claims.

698,584. SCREW-PROPELLER. ROBERT THALER, WEST BAY CITY, MICH.



CLAIM.—A propeller for vessels comprising in combination a series of helical blades of greater length than the diameter of the propeller; a hub integral with said blades; an axial hole through said hub, the outer portion of the length of said hole being adapted to fit the propeller-shaft; the remaining portion of said hole being enlarged from the middle of the hub toward its forward end, to form a conical recess; openings through the conical shell of the hub; and scraping-bars across said openings; together with a conical rearwardly-extending bearing secured to the vessel and fitting the conical recess of the hub, said bearing having an axial shaft-opening, all arranged substantially as and for the purposes set forth.

699,144. MEANS FOR CLEANING SHIPS' HULLS. WALTER S. BURT, ALBURY, NEW SOUTH WALES, AUSTRALIA.



CLAIM.—1. In a mechanism for cleaning a ship's hull, the combination of a curved carrier-rod, a revoluble cleaning-cylinder mounted on the foot of said carrier-rod and provided with external cleaning elements, and means for adjusting said cleaner-cylinder lengthwise of, and vertically with respect to, a ship's hull. Eight claims.

699,231. BOAT. JAMES P. POOL, BROOKLYN, N. Y.

Marine Engineering

Vol. 7. NEW YORK, JULY, 1902. No. 7.

PATENT OFFICE

STEAM YACHT HELENITA.

One of the handsomest new yachts to enter this season's fleet is the *Helenita,* 185 feet length over all, built for Mr. Frank J. Gould by the Gas Engine & Power Company and Chas. L. Seabury & Company, Consolidated, Morris Heights, New York City. The yacht is of steel throughout, and, as seen in the accompanying drawing, has very graceful lines.

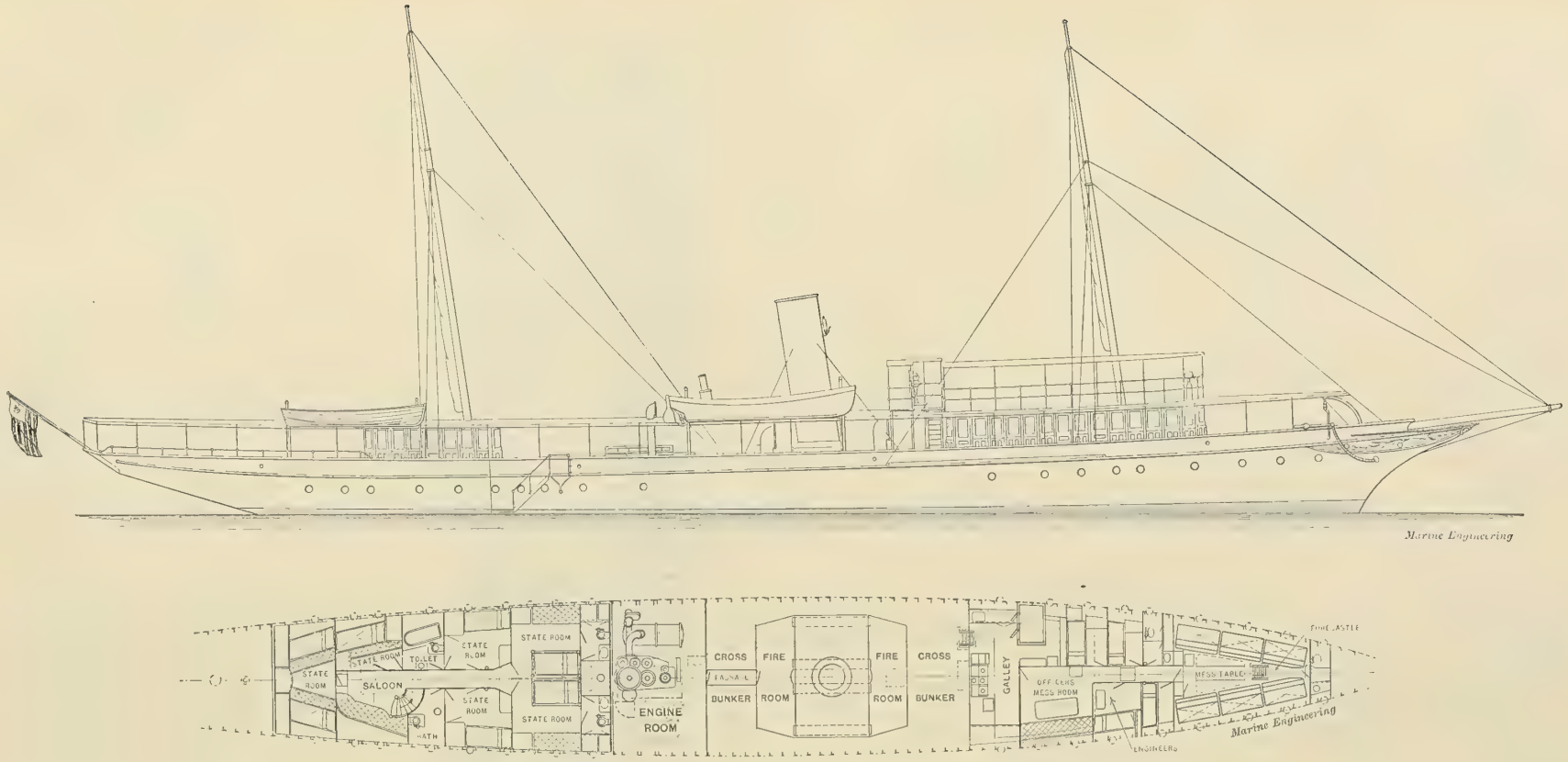
The keel is of bar steel and the stern post and stem are of forged steel; the frames and reverse frames are of angle steel spaced 21-inch centres. The plating is laid in inside and outside strakes, with the horizontal seams lapped and the vertical seams fitted with butt straps. There are five water-tight steel bulkheads extending to the main deck, viz., the forward collision bulkhead, the forward boiler room bulkhead, the one between engine and boiler room, the after engine room bulkhead, and the after collision bulkhead. Bunkers with the capacity of 90 tons of coal extend athwartship at either end of the boiler room, and wing bunkers are placed on either side. The rudder is of the steel plate type.

The bulwarks of the vessel are of steel, carried up 22 inches above the deck from the bow to the stern, and are topped by a teak rail. The deck is laid with white pine and is fitted with the necessary chocks, cleats, etc. On the forecastle are a steam windlass and two Herreshoff anchors. The two pole masts and the spars are of Oregon pine, and, according to the latest design, no gaffs are fitted. For sails the yacht carries one foresail, mainsail, and jib. A complete set of awnings are stretched from polished brass stanchions placed alongside the bulwarks.

As seen from the drawings, there are two deck houses, one forward and one aft, both of which are built of mahogany. At the forward end of the forward deck house is a large dining saloon furnished very handsomely in mahogany and inlaid trimmings. Aft of the dining saloon is the pantry, and next is the smoking room, open on either side to the deck and also connecting with the dining room by a passageway. The joiner work of the smoking room is of quartered oak, with paneled oak ceiling, and the walls are inset with paintings of marine scenes. Aft of the smoking room, on the starboard side, is the captain's state room, and on the other side is a deck room. The top of the deck house is covered with canvas and a wooden grating, and over it an awning is stretched. The officers' bridge is aft of and raised above this deck, and extends from side to side of the vessel. Here are placed the steering wheel and the engine room telegraph pedestal. A chain from the steering wheel connects with the steam steering engine in the engine room.

NEW STEAM YACHT HELENITA.

(Copyright, 1902, by Marine Engineering, Inc., New York).



OUTBOARD PROFILE AND CABIN PLAN OF THE HELENITA, BUILT AT MORRIS HEIGHTS, NEW YORK.

A steel trunk extends the full length of the boiler and engine rooms, and is trimmed with mahogany. Large mahogany skylights and companionways open from the top of this trunk. The after deck house contains one large room, viz., the social hall. The joiner work of this room is especially elaborate in carved work, the wood being beautifully grained Cuban mahogany, while the pieces of stationary furniture are made of similar material.

Returning to the bow, and descending the crews' companionway, are found, first, the chain locker, boatswain's locker, the crew's toilet room, and the forecastle containing 18 folding pipe berths. Aft of the forecastle are the officers' quarters. There are two state rooms on the starboard side, a large one for the chief engineer, and a smaller one. On the port side are two state rooms with two berths each, and the toilet room. Aft of the chief engineer's room is the officers' mess. These various rooms are reached through a passageway running amidships fore and aft by a companion ladder from the deck above, located just aft of the forward deck house. Aft of the mess room is a large galley extending from side to side of the ship, and on the port side are refrigerators and store rooms. All of these forward quarters are finished in white pine highly polished.

Passing now to the after deck house, a stairway leads below deck to the owner's quarters. Against the engine-room bulkhead are two large toilet rooms extending the full width of the vessel. These serve the double purpose of deadening the noise of machinery from the owner's quarters, which are directly aft and open into the toilet rooms. There are two large equal-sized bed rooms for the owner, with a portable screen bulkhead,

which may be easily removed and the two rooms thrown into one. The cabinet work of these quarters is of bird's-eye maple and very handsome. On either side of the passageway leading from these apartments are guests' state rooms and a large toilet room.

In the lazarette at the stern is the usual place for stowing lines, etc., and there is also a series of racks for storage batteries.

In the boiler room are placed two Seabury double-end boilers, each one containing 840 one-inch tubes, and doors open conveniently from the coal bunkers to the boiler room floor at either end. Fan blowers are located in the top of the boiler trunk, one for each boiler room, for supplying forced draft. The vessel is propelled by a Seabury triple expansion engine of dimensions given in the following table. The design of the Seabury engine is generally well known, but a brief mention of it may be appropriate. The valves, which are of the piston type, are all at the side of th engine opposite the cylinders, and are operated through connecting rods by a valve crank shaft extending parallel to the main crank shaft. This valve shaft is driven by gears from the main shaft through an idler, and this crank shaft can be so set in reference to the main shaft as to give ahead or stern motion. The crank shafts and valve shafts are cut from solid steel stock of best quality; the connecting rods, piston rods, and valve rods are forged from best steel stock. All crank shaft bearings are extra large, and are lined with close-grained babbitt metal; all other bearings are made from fine quality of composition bearing metal. The pistons are of steel, and are accurately fitted with spring rings which are self-adjusting, while piston valves are used with an approved and simple valve motion, having few parts to wear. All bearings are provided with ready means for taking up slack due to wear. Crosshead guides are of fine-grained cast iron. The cylinders are attached to the cast steel bed plate by forged steel stanchions, properly braced, and the crosshead guides are bolted to the rear stanchions; the crosshead is of the slipper type.

A complete set of auxiliaries is installed, including three duplex feed pumps, circulating pump, sanitary pumps, bilge pumps, ash chute, etc. The electric lighting plant consists of one 125 16-C. P. dynamo, a 2,500-C. P. searchlight, and storage battery sufficient for operating 25 16-C. P. lamps for 10½ hours.

A set of four handsomely finished mahogany carvel-built boats are swung from davits. The owner's launch is 26 feet long, built of mahogany, and driven by a 6-H. P. naphtha engine. The gig is also mahogany, 20 feet long, and the 20-foot cutter is of the same material. The crew's launch is 21 feet long and driven by a 2-H. P. naphtha engine.

On the trial, recently conducted, a speed of 19.46 miles per hour was maintained for two consecutive hours. As the season approaches, this handsome craft will no doubt attract more and more attention because of her graceful lines, speed, and comprehensive design.

Length over all, 185 feet.
Length on water line, 150 feet.
Beam, molded, 22 feet.
Depth, molded, 72 feet.
Draft, 9 feet.
Coal bunker capacity, 90 tons.
Water in tanks, 10,000 gallons.
Engine, 1 Seabury.
Type, 3 cylinder triple.
Cylinder, diameter, 13½, 21, 34 inches.
Stroke, 21 inches.
Speed, 19.46.
Valves, all piston.
Boilers, number, 2.
Type, Seabury.
G. S. total, 95.82 square feet.
H. S. total, 3,748 square feet.
Draft, closed stoke hole.
H. S. ÷ G. S., 39.

Turbine Reciprocating Engine-Driven Vessel.

On February 11 the destroyer *Velox* was launched from the yard of Hawthorne, Leslie and Company. The new vessel is of the same type as the unfortunate *Viper* and *Cobra,* and will be driven by Parson's turbines. Special attention has been paid to the conditions necessary to secure longitudinal strength. A novel feature in this vessel is the introduction of ordinary reciprocating engines fitted in conjunction with the steam turbines and coupled direct to the main turbines, working in conjunction with them. They take steam directly from the boilers and exhaust through the high pressure turbine, the exhaust from the latter passing in turn through the low pressure turbine and thus to the condensers. These reciprocating engines are for use at cruising speed when low power only is needed. When turbines are run slowly they show very low efficiency, and as the destroyers travel usually at cruising speed the Admiralty decided to place reciprocating engines in them for this service.

When the highest speeds are required steam will be shut off entirely from the reciprocating engines, which will be thrown out of gear and the steam turbines alone used. The boilers are of the Yarrow type. The vessel is of the usual size of destroyers, viz.: 210 feet long, 21 feet wide, 12 feet 6 inches molded depth, but has not been built to the order of any government.

Fast Steamboat.—The new steamer *William G. Payne,* built by the Harlan and Hollingsworth Company, of Wilmington, Del., is reported to have steamed at the rate of 21.95 knots over the Government course in the Delaware.

A Fast Trip.—The steamship *American,* of the American-Hawaiian Steamship Company, recently made a record trip from New York to San Francisco, completing the passage in 59 days and 20 hours from Sandy Hook to San Francisco lightship. The course was 13,555 nautical miles. The above time includes three stoppages in the Straits of Magellan, on account of the days being so short there at present, and 18 hours for loading coal at two ports. The longest stretch of straight steaming without closing the throttle was 28 days. The average boiler pressure was 180 pounds and the horse power 1,957.38; the number of revolutions per minute, 58.6; and the average coal consumed per day, 39.3. The engines have cylinders 28, 48, and 75 inches in diameter by 48 inches stroke, and are equipped with Marshall valve gear.

STEAMBOAT BUILDING UNDER DIFFICULTIES.

BY EDWIN B. SADTLER.

The building of a modern steel steam vessel is a work of considerable magnitude at any time, and becomes one requiring an unusual amount of thought and continual close application to the details when it has to be done in a place remote from a shipyard and its appliances.

The purpose of this article is to describe the building of the hull of the new steamer *Sagamore,* which has been constructed on the shores of Lake George, in the village of Caldwell.

templates were made showing the room allowed. One of these templates was erected at each end of the car while loading, and care taken that nothing should extend above a line drawn from one template to the other.

The material for the steel hull and the ship carpenter work, together with the necessary tools for erecting and riveting the vessel, filled fifteen cars and weighed over six hundred thousand pounds. To insure a delivery of all the materials at one time, the whole fifteen cars were shipped on one train; but, as it seemed to better suit the convenience of the railroads, they arrived in three lots of five, seven, and three cars respectively,

VIEWS SHOWING THE VARIOUS STAGES OF CONSTRUCTION OF THE SAGAMORE, BUILT ON LAKE GEORGE.

The material for this boat was gotten out, worked, and temporarily erected at Wilmington, Del., after which it was carefully marked, taken apart, and loaded on cars for shipment.

Troubles caused by the weather began while loading the cars, as, a few days before this work was completed, a snowstorm came which covered up many of the small parts lying about and caused some anxiety lest anything should be overlooked. Great care had to be taken that no piece should be so large that when loaded on the cars it would exceed the dimensions, height or width, given by the railroads, in order to pass through their tunnels. To insure safety on this point, wooden

after a journey, in the shortest instance, of six days. As might be expected, the undesired happened, and the car containing the part wanted first, that is, the keel, arrived last.

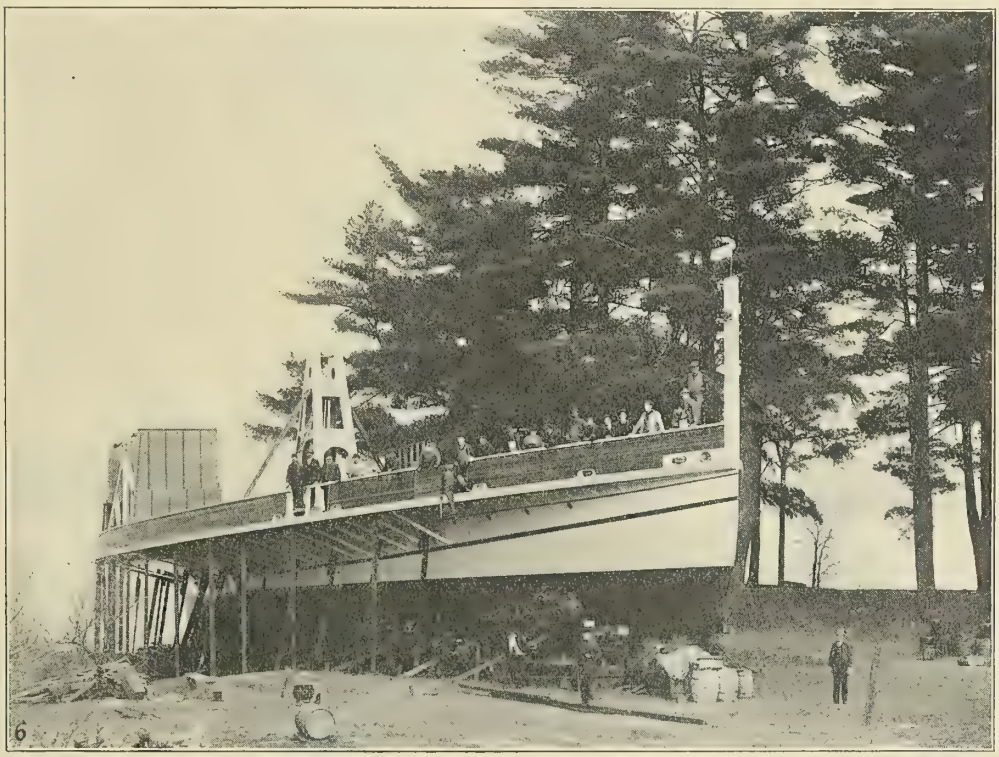
As soon, however, as the first shipment arrived the transporting of the material from the train to the place of erection, which we will call, for convenience, the yard, began. The unloading of parts so large and heavy without any cranes made it necessary to erect temporary sheer poles from which to hoist the material out of the cars for loading on the sleighs which were to convey the material to the yard.

Strangely and appropriately it occurred that this boat

with its Indian name had the first piece of actual work done at the place of building by an Indian of the "Abnakis" (called O-bin-I-kee) tribe. Although the frames were not the heaviest part to be transported, they were the bulkiest, and in order to hoist them out of the cars two sheer poles were erected at either end of the car which was being unloaded. Most of the cars used were of the gondola type, with sides about 7 1-2 feet high. However, for some of the frames a 50-ton coal car was used, one end of the frames resting in the pocket of the car. This necessitated an unusually great hoist of about 22 feet in all. After the frames were hoisted out of the cars, they were skidded down to sleds placed on the ice alongside of the wharf on which the cars were unloaded.

hill on the port side, it was necessary to place most of the material on the slope of ground ahead of the boat. This general layout is shown in Fig. 1, taken at the end of the first week's work. When the material was located the snow was so deep that blocks of wood and logs had to be placed under the piles to keep them above the snow and ground, for fear of freezing fast. In order to facilitate the stacking and finding of the material, that for the starboard side was painted red and that for the port side brown. This was found to be of the greatest assistance for quickly locating any part.

On March 3, 1902, the first instalment of mechanics from the home yard, eighteen in number, was set to work. At about 10 A.M. we began to arrange the keel blocks, which constituted the first actual work of con-



THE SAGAMORE, ERECTED ON THE SHORE OF LAKE GEORGE IN SEVEN WEEKS.

In order that the sheer poles might be guyed first over the cars, then toward the edge of the wharf, it was necessary to run guys out over and fasten them in the ice. This was done by cutting holes through the ice and putting toggles below with lashings around them, to which the guys were made fast. This caused considerable trouble, as the ice was about 30 inches thick at this place.

After the material had been unloaded and hauled across the lake to the yard, a distance of about a third of a mile, it had to be taken ashore and arranged with great care and very systematically, in order that when wanted it could be found with the greatest ease, and also with a view of handling it as little as possible when it was wanted in the construction.

Owing to the fact that there was just about the width of the boat's hull of flat ground sloping away into a swamp on the starboard side and rising suddenly to a

struction. These blocks had been put in place some time previous, but, fearing that the water might not be deep enough to launch the boat from the chosen spot, we bored the ice at intervals and sounded the lake. The depths found showed our fears to be correct, so we moved the blocks further down, making due allowance for the expected rise in the level of the water due to the melting of the snow on the surrounding mountains. Having located our blocks, we stretched our line, fitted the top blocks to it, and then proceeded to lay the keel. By 6 P.M. of the first day we had landed on the blocks all of the keel but the extreme end sheets, which we kept down until ready to raise the stem and stern post.

The following day we replaced in position the garboard strake, raised two midship frames, and proceeded to "horn" or square in all directions so that the other frames might be regulated by them. Having our trial frame erected and squared, we then began erection in

earnest. As the space where the boat was built was so narrow, the frames were either laid on the banks of snow cleared from under the boat or spread around the field ahead of the boat, and required several men for handling. As each frame weighed nearly a thousand pounds (the web frames being much heavier), and as the ground was very rough and uneven, this proved slow work. The frames were skidded over the ground under their proper position, raised bodily up and placed on the keel, and then erected in place by the use of a block and fall made fast to the beam end of the previously erected frame.

Shortly after noon on the third working day, after we had gotten well started on the frames, it began to snow in the neighboring mountains, and, seeing that we were also in for it, the boys were put at work gathering up all loose bolts, nuts, washers, and small tools that would likely be shoveled or swept away by clearing off the snow. This storm left us an additional foot of snow to clear away next morning before we could proceed with the work.

As the men took great interest in the work, we succeeded in getting the first frames up the second working day. Further interest was encouraged by engaging a photographer to take weekly pictures showing the progress of the work, and then making a point of getting certain parts ready for our next picture. The result of keeping the men in a good humor was that in fifty-two hours' actual working time we had every frame raised, including the stem, stern post, and transom, with all the cant frames and most of the ribbands in place. While we were rushing the frames other matters were not neglected, as we stopped raising them long enough to get all the long keelson and ridge bars inside of the boat while one end was open and we could drag them down over the snow and in endwise over a temporary incline.

As soon as the framing was completed we began to erect our staging around the boat, and here again we met trouble owing to the narrowness of our building ground. As the staging covered all the ground from well up on the hillside to the swamp on the other side, we had to arrange the cross space so that we could drag the shell plates and other materials down under them to their desired locations. This we found only possible on the low side, and hence had to resort to the use of a snatch block at the stern and a long line back to the bow to drag plates down on the uphill side. On the low side we found an apple tree actually coming under the guards of the boat. The owner of the land had made a special request that no harm be done to his trees, so we dug around its roots, and, attaching a fall to it with the other end fast to a convenient sheer pole, we pulled the tree out and laid it over in the swamp, where we carefully covered the roots with snow so that no harm might come to it.

The peculiar layout of the staging to suit our horse-power conveyer is shown in Fig. 2, which also represents the condition at the end of two weeks' work. Notwithstanding the interruptions occasioned by bad weather, we had quite a lot of the shell plating up and the guard started, as well as a good start made on the riveting.

In order to hurry the riveting, we held off the plates in line with the keelsons until the rivets at the back of the keelsons, generally known as "bumps," were all driven.

By referring to Figs. 3 and 4, taken on March 24, it will be seen that all the heavy work, except the gallows frame, was in place in just three weeks from the start. The shell plates were all up except the closers, which we kept off for ease of access and to clear out the snow from the hull when necessary, and there were about fifteen thousand rivets driven at this time. The guard, including wheel beams and guard logs, was all on except a few beams around the stern; the wooden stem was up, and the bow chock and piece of fender fitted; also quite a width of deck laid from the bow to the boiler hatch. The laid deck was all bolted and plugged, and quite a patch of it was calked.

As will be seen by Fig. 3, the lake was still covered with ice; in fact, this view shows several men at work on the ice removing some stones which were found, forming part of an old pier, just in line with the boat, and which would interfere with the safe launching of the vessel.

At this stage of the work, the heavy part being well advanced and having other matters on hand, the writer left for other scenes, leaving the work in charge of the efficient foreman carpenter, and the matter of time-keeping and paymaster's duties in the hands of another.

The good start we had made seemed to be the means of keeping things going at a lively rate, for at the end of four weeks the gallows frame and A-frames were up and the launching ways were being fitted.

On April 1, less than one calendar month from the actual start, the outside or shell gangs of riveters were sent home with their work complete, leaving only the inside men to finish up small work, the gallows frame, and wheel batteries. This work was all completed before the time set by the builders for launching.

The illustration on page 327 shows the hull completed and was taken on April 22, the day before the launching, or just seven weeks and one day from the laying of the keel blocks and keel. When the distance from shop conveniences and the weather conditions, together with the usual setbacks of a shipyard, are considered, this was undoubtedly very good progress in the construction of a 200-foot vessel having nearly fifty thousand rivets to drive, all by hand, and many of them in close and difficult places.

The illustrations for this article are from photographs taken by Mr. Henry Sisson, of Caldwell, N. Y.

New Type of Steamer.—The United States consul at Copenhagen states that a new type of ship is being built in that city, in which the screw is placed under the bottom and the bottom made flat.

Summer Schools.—The Dean of the College of Engineering of the University of Wisconsin announces that the second year of the summer school in the College of Engineering opens on June 30 and will continue until August 8, 1902. The primary object of the school is to give engineers, superintendents of power stations, and machinists, artisans, and apprentices of various trades, such mathematical, laboratory, and shop instruction as will be found of most practical value in the limited time of six weeks.

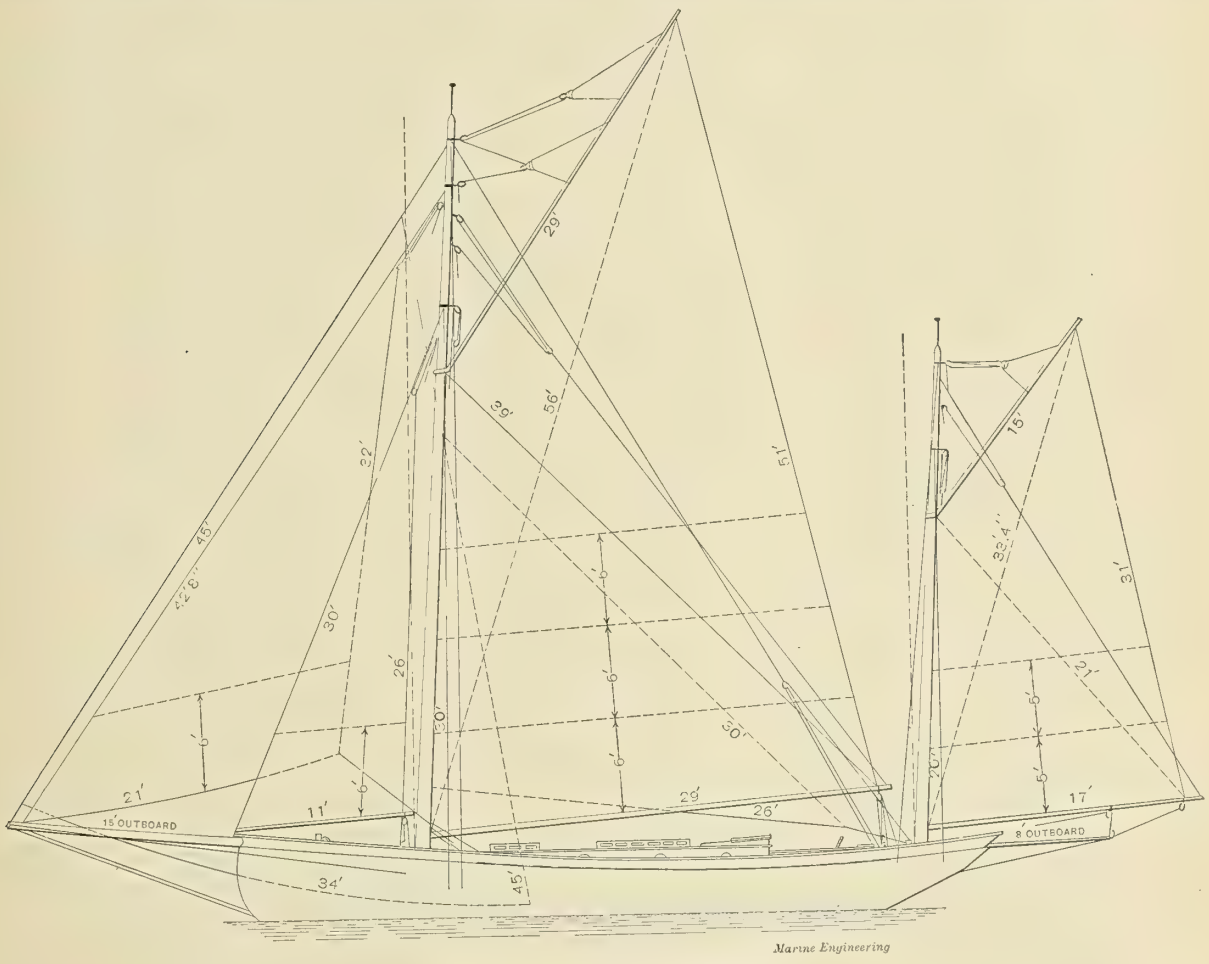
The Cruising Yawl Windward.

The *Windward* was designed for Mr. Francis A. Brown, of Marinette, Wis., by J. Byron Roney, of Lynn, Mass., for strictly cruising purposes, and is now enroled in the fleet of the Chicago Yacht Club. The requirements were for a cruising yawl to be as safe as possible and easy to be handled by a small crew in heavy weather, and to have good accommodations for her size. The limitations were to not exceed 50 feet in length or more than 6 feet draft, and to have full head room. Her owner expressly stipulated that she was not to have long overhangs, as he had seen and experienced enough of them on the rough water and steep seas of the Lakes; consequently she was given a plumb stem and short overhang aft with V-shaped archboard, thereby gaining much in easiness of entrance and inside accommodations over a craft of similar length with the long overhangs. She has been thoroughly tried by her owner, and has proved a very successful boat for what she was designed, and also fast in heavy weather.

The *Windward* is strongly, though not extra heavily, constructed. All framing and planking are of oak; the frames and deck beams are steam bent, and the deck is of pine, spars of spruce, and the cabin finished with hard woods and varnished. All ironwork is galvanized, and fittings and rigging are the best obtainable. The boat was built under the owner's personal supervision and the work was well done.

The general dimensions are:

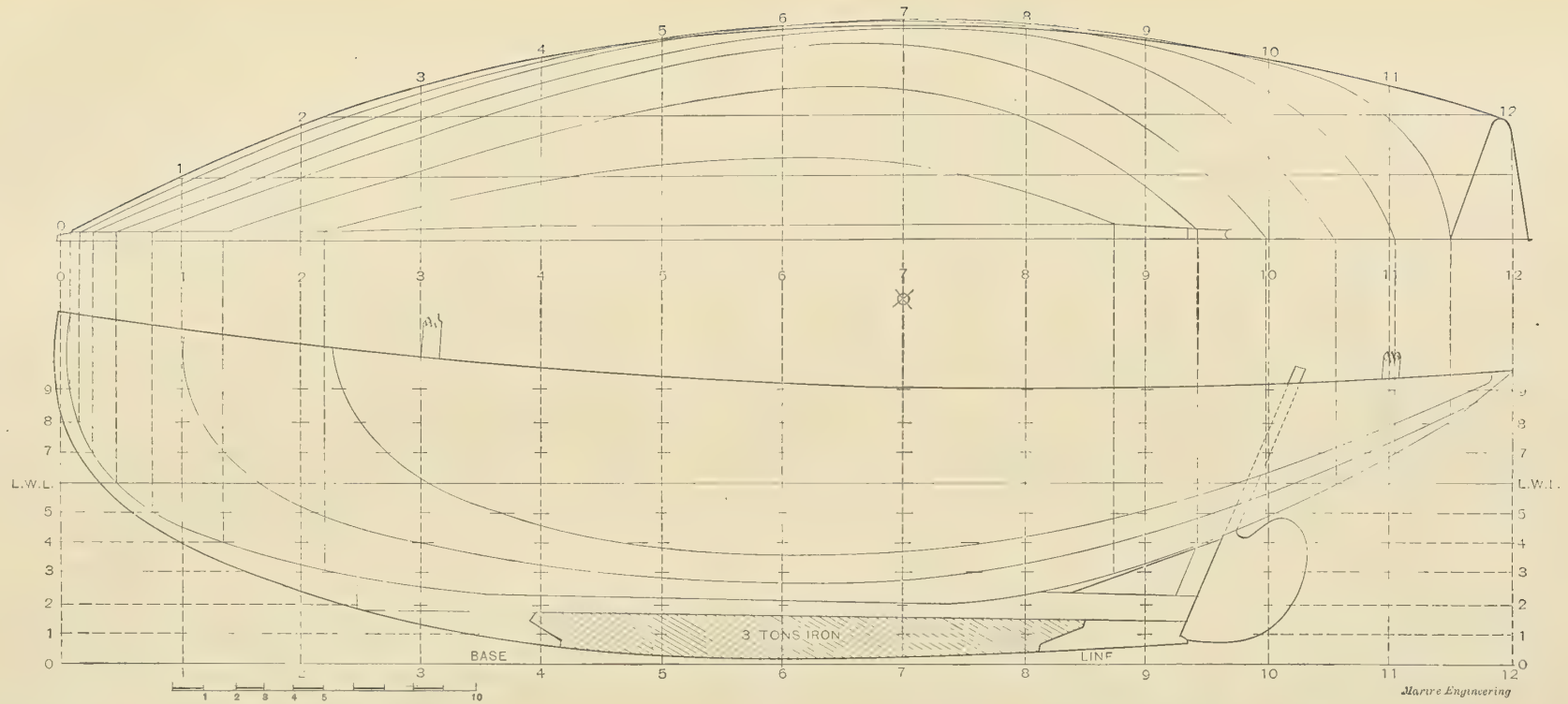
Length over all, 49 feet.
Length on water line, 41 feet.
Beam, 14 feet.
Depth of hold, 6 feet.
Draft, 5 feet 10 inches.
Freeboard at bow, 5 feet 8 inches.
Freeboard at stern, 3 feet 8 inches.
Head room, 6 feet 4 inches.
Length of mainmast from deck to cap band, 47 feet.
Length of mizzenmast from deck to cap band, 32 feet.



SAIL PLAN OF THE YAWL WINDWARD.

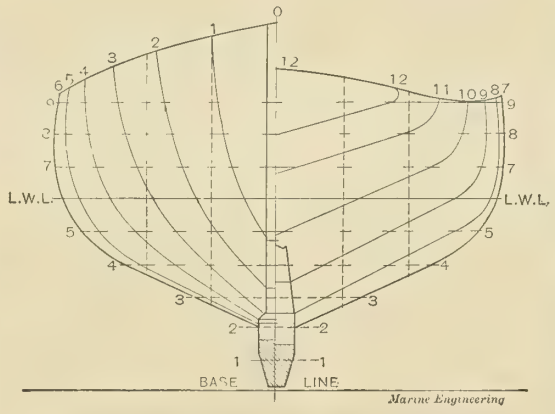
Length of main boom, 30 feet.
Length of main gaff, 30 feet.
Length of mizzen boom, 18 feet.
Length of mizzen gaff, 16 feet.
Length of forestaysail boom, 11 feet 6 inches.
Length of bowsprit outboard, 15 feet.
Length of bumkin outboard, 8 feet.

The scantlings are as follows: Keel, 10 by 12 inches; stem and stern post, sided, 6 inches; tail feather, a single oak stick reaching from keel to archboard about 8 by 10 inches, molded to conform to rabbet line; frames, 3 inches by 4 inches at heel, 2 1-2 inches by 3 inches at head, steam bent, spaced 12 inches on centres; floor timber, 3 inches by 4 inches, natural crooks; deck beams, 2



inches by 3 inches, except partner beams, which are 4 inches by 4 inches, spaced 20 inches on centres; keelson, 4 inches by 10 inches; king plank, 2 inches by 18 inches; clamp strake and bilge strake, 2 inches by 10 inches; shelf, 2 inches by 10 inches; sheer plank 2 by 8 inches, oak; deck laid parallel to sheer plank, 2 inches by 3 inches; cabin deck 1 1-2 inches by 4 inches; planking, 1 1-2 inches thick, oak; ceiling, 1 1-2 inches thick; cabin house, 21 feet long; bulwarks, 10 inches high; waist, 3 feet wide; outside ballast, iron, 3 tons; inside ballast, scrap iron bedded in cement; rudder post is of 3-inch steel shafting; the blade, 1-2 inch plate steel.

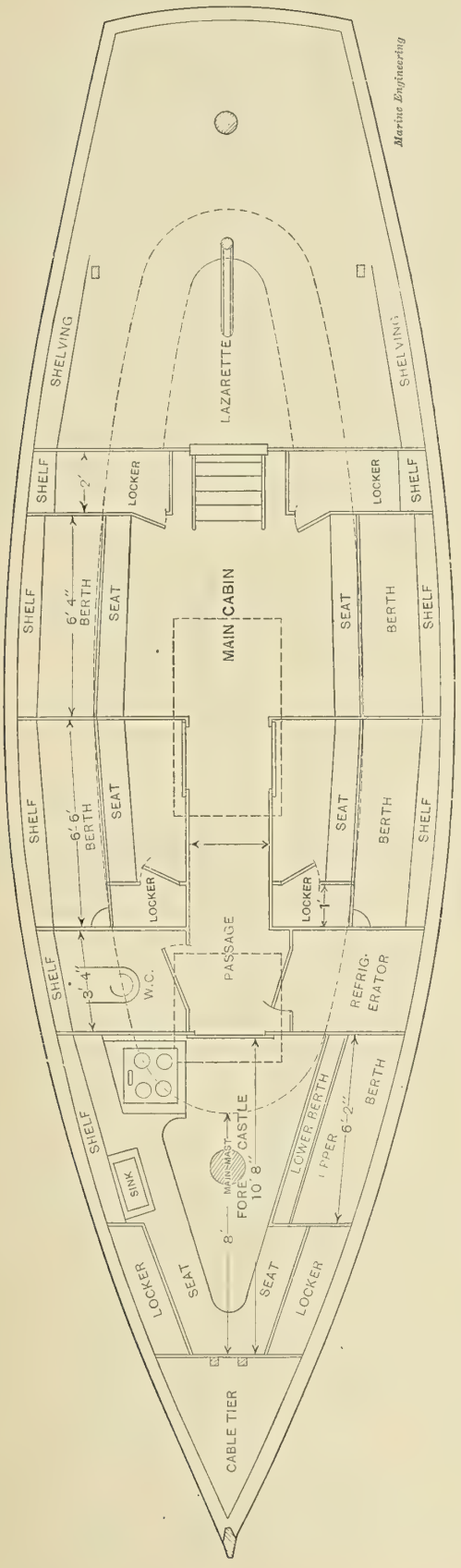
Berths and seats are fitted to use room beneath for storage purposes. Sleeping accommodations for ten people. An immense amount of room in lazarette for storage of spare sail rigging. There are portlights in



WATER LINES, BUTTOCKS, AND BODY PLAN OF YAWL.

side of house and ventilators in lockers. The skylights are respectively 6 feet by 3 feet 4 inches, and 3 feet by 3 feet 4 inches, and the fore hatch is 24 inches by 30 inches, giving good light and ventilation all through the cabin forecastle, state rooms, and toilet. The forecastle bulkhead being aft of forward end of house gives good head room and light to galley and allows heat from stove to readily escape.

The deck is carried in and makes the seats in cockpit, with washrail sprung around continuous with line of house. She is fitted with bronze hawse pipes and a suitable windlass, and carries three Baldt stockless anchors with chain and manila cable of good length. An Edson stearing gear is used. The standing rigging is of best steel wire, and the running rigging is of manila. The sails were made by Carpenter, of Chicago.



CABIN PLAN OF YAWL WINDWARD.

TAIL SHAFTING FOR MARINE ENGINES.

BY J. P. BADENHAUSEN.

The subject of Marine engine tail shafting is one which is of the most vital importance to those who put to sea in ships as well as to those who foot the repair bills.

MARINE ENGINEERING, in the issue of November, 1901, discusses the causes of breakage in propeller shafting, and divides these causes into three divisions, namely:

1. Poor material.
2. Unforeseen strains.
3. Corrosion.

1. POOR MATERIAL.

As far as poor material is concerned, ship owners and ship builders go only to reputable manufacturers of shafting who furnish certificates of inspection, with test pieces and guarantee shafting for 12 months

The material itself may be wrought iron or steel, and the preference of one over the other is governed by the price and the experience of the superintending engineer of the line for whom the vessel is to be built.

A wrought iron shaft has perhaps, structurally speaking, a superiority over the steel shaft. For the best wrought iron shafts, rods of iron are taken, one-half inch in diameter or one-half inch square, the rods being the length of the shaft. These rods are put together one upon the other, sufficient rods being used to make up the size of shaft, the rods being held together by bands of the same material; then the whole mass is raised to a welding heat and welded so as to form a solid homogeneous mass.

Here we have a shaft built up of rods running lengthwise, which means that the fibers of the material run in the same direction, and it is at once apparent that the flexibility of such a shaft is greater than that of a steel shaft due to the difference in structure. The strains upon a tail shaft are very severe, and when a shaft is forged from individual rods, as is the case with a wrought iron shaft, the tendency to break short off is less than if it were made of steel.

There is another point of apparent superiority of a wrought iron shaft over a steel one, which may be noticed when observing the effects of corrosion upon a wrought iron shaft and upon a steel one. It may then be noticed that the effect of the corrosion tends to manifest itself upon a wrought iron shaft by ridges which run lengthwise, while upon a steel shaft the effect is more commonly shown by eating in running around the shaft.

Since the strength of a shaft is given by its least diameter, the steel shaft loses more, since it is weakened circumferentially and not longitudinally.

2. UNIFORM STRAINS.

This has been fully discussed in the article above referred to in this magazine, and it is unnecessary here to go further into the question. One more point, however, may be mentioned, which, although a trivial one, has a tendency to further strain a shaft.

The stern bearing is usually bored out 1-16 inch to 3-32 inch larger than the diameter of the shaft. After a vessel has been running some time and is then docked and the shaft drawn in, it will be found that the stern

tube bearing is worn down more at the lower right hand quarter, if the engine turns a right hand propeller, than in any other part, and that the shaft works in the stern tube in an oval path instead of a circular one.

The abuse which a tail shaft receives while the vessel is driven through a head sea, and the straining caused thereby, are so severe and so diversified that the skill of the designer is set at naught, and the best mode of procedure is to follow the rules laid down by the classification societies, such rules being the expression of wide practical experience under all the varied conditions of service.

3. CORROSION.

This is, probably, the agent to which the failure of most shafts may be ascribed.

That corrosion may be reduced and even entirely eliminated, is possible, as the experience of the writer fully justifies. Careful design in many minor points, especially in preventing the actual contact of salt water with the shaft proper, may prolong the life of a tail shaft to that of the rest of the shafting or until some unforeseen accident puts an end to its usefulness.

pressure exerted by the shrinking on has been sufficient, in cases where common alloy was used, to split the liner from end to end.

Some manufacturers make it a point to hold the liner to the shaft, besides shrinking, by means of countersunk tap rivets. Why should these be used? In the opinion of the writer they are not only unnecessary, but are also conducive to great injury to the shaft.

The liner should be shrunk on tightly, and if this is done the rivets are unnecessary. If, perchance, the liner should become loose and the countersunk screw rivets are the only dependence for keeping shaft and liner together, then again great harm is done, since when the liner is loose the salt water will come between the shaft and liner and corrosion will begin, which is doubly dangerous since the action is going on underneath the liner where it is not to be seen. If a liner is loose, the sooner the looseness is remedied the better. Then again the holes which are drilled into a shaft for these screw rivets tend to weaken the shaft, and cracks may be started therefrom which would not have materialized if these holes had not been drilled.

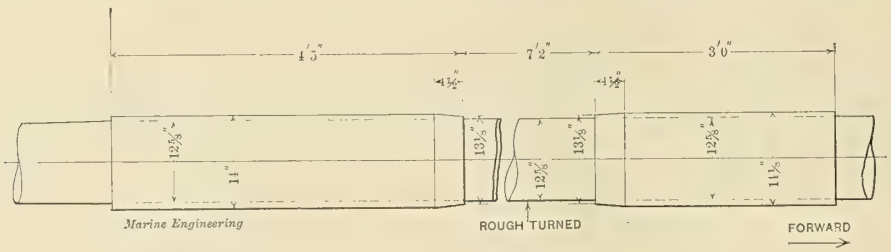


FIG. 1.

The considerations necessary to prolong the life of a tail shaft are as follows:

a. Periodic inspection.
b. Liner or liners.
c. Design of taper part of shaft.
d. Design of key.
e. Design of hub.
f. Nut and nut fastening.

a. Periodic Inspection.

Vessels are docked once or even twice every year for the purpose of cleaning and painting the hull, and for examining sea-connections. At least once a year the propeller nut and propeller are removed, the shaft is drawn in for inspection, the liners are tested with a sounding hammer, and that part of the shaft which is exposed to the action of the salt water and not protected by the liners is scaled, scraped clean and painted with anti-fouling composition.

The stern tube bearing is tested to see how much the shaft has worn down the lignum vitæ bearing, and if necessary, new wood is put into the tube.

b. Liner or Liners.

The main function of a liner is to provide a suitable bearing for the shaft, but the secondary one, that of protecting the shaft, is of no less importance. In most ships, say up to 2,500 tons, it is possible to use one liner which will extend from the propeller end of the shaft through the stern stuffing box gland. These liners must be made of especially good composition, since the

These single casting liners have been made to a length of 14 to 16 feet and even more, electrically heated, and shrunk on; but there is risk of getting a poor casting in such length, so that for cheapness usually two or more liners are used, especially when the distance from the stern frame to the stern gland is very long.

Fig. 1 shows a shaft having two liners, the intermediate part being the bare shaft. As shown, the ends of the liners are tapered down for a length of 4 1-2 inches. This is for two purposes. One is to gradually decrease the strength of the liner, which acts as a stiffener, and the other for the following protective purpose.

The bare part of the shaft, between the two liners, is painted with antifouling composition, then a thick coat of white lead and tallow is put on, then marlin is wrapped around the shaft, the taper parts of the liners permitting the gradually lessening of the marlin wrapping, allowing a tight job to be made. The mixture of white lead and tallow squeezes between the turns of marlin, and if the whole job is done in a workmanlike manner, it will last for ten or twelve months, until the next inspection, when the whole operation is repeated. Very often the bare part of the shaft is protected by another liner, or in other words instead of using one length of the liner to cover the whole shaft, two, three or four lengths are used.

As is readily seen, butt joints between the several lengths of liners are of no particular benefit, since the working of the shaft tends to separate the lengths and thus allow salt water to act in conjunction with the

brass liner upon the shaft, thus tending to develop corrosive action.

In Fig. 2 is shown a method of joining the ends of liners, a method used by a prominent shipbuilding company with eminent success.

As will be seen from Fig. 2 the part of the shaft where there is no bearing is simply covered by the liner, which is curved out larger than the diameter of the shaft, thus saving machine work and rendering the liner more flexible and better able to accommodate itself to the movements of the shaft.

c. Design of Taper Part of Shaft.

Seaton advocates a taper of 3-4 inch to the foot, but when such a taper is used it is found necessary to heat the boss in removing the propeller from the shaft. This heating the propeller boss to remove it from the shaft is very often apt to loosen the liner from the shaft, allowing dirt to get underneath and thus preparing a way for the water to commence its corrosive action. A taper of 1 inch to the foot is perhaps better, but when the taper is still increased, then the small end of the taper

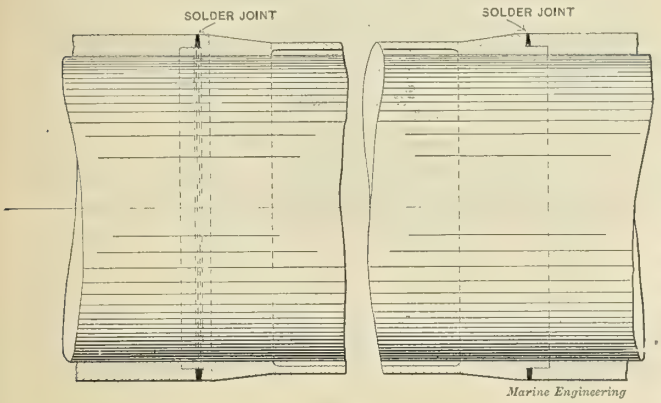


FIG. 2.

part becomes so small as to leave little room for the key.

d. Key.

Seaton gives the following formulæ for the breadth and depth of key.

Breadth of key = .22 × largest diam. of shaft + .25 inch.

Depth of key = .55 × breadth.

The breadth given by this rule is entirely too large, and I have modified it in several cases, where new shafts were fitted and using the old hubs, by filling up the old key-way in the hub and cutting a new, smaller one, to the formula.

Breadth of key = .2 × diameter of shaft.

Depth of key = .55 × breadth.

The reason which led me to change the formula for the breadth was furnished by the action of a tail shaft key-way which came under my observation. The breadth of the key-way was made according to Seaton's formula; after running some time the shaft was drawn in for inspection and it was found that the key had split the taper part of the shaft along the key-way where it was weakest, the metal not being of sufficient strength to withstand the thrust of the key.

Then the taper part was turned up on the shaft, the distance lost in length being made up by the distance pieces between the couplings of the tunnel shaft, and a new key was cut to the same dimensions as before.

Again the shaft was split, and then when the new shaft was made the breadth of the key-way was reduced to that given by the above formula and has given perfect satisfaction since.

e. Hub.

Fig. 3 shows a method of preventing the water from coming into contact with the taper part of the shaft. As is readily seen, the hub is bored larger than the shaft

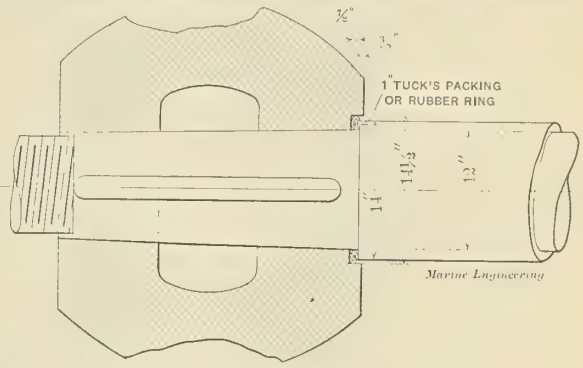


FIG. 3.

liner, and when the hub is in place the rubber ring or a turn of 1 inch Tuck's packing is squeezed up in such a way as to force it tight all over, thus preventing all entrance of water. As is also shown, the end of the key does not come within 1 1-2 inches of the liner, so that the key does not interfere with the packing.

When the propeller boss is fitted in the shop (which ought to be done very carefully, by the use of red lead paint), care should be taken to make the hub bear on the forward part, since the after part is steadied and taken care of by the nut.

f. Nut and Nut Fastening.

The methods of fastening the nuts are many, and every designer and engineer has a method which is perhaps as good as another, and as far as the nut itself is concerned some engineers use slotted nuts and spanners, while others make the nut with two lugs and drive it on with a ram.

A New Marine Publication.—The *Maritime News and Review* is the name of a new weekly publication devoted to shipping interests on the Atlantic and Gulf coasts. This sheet is published every Tuesday evening by the News and Review Company, Incorporated, Merchants' Bank Building, Baltimore, Md. The paper is devoted to items of news in the marine field, and the first two issues which have appeared are indeed most creditable and give promise of a strong paper. Items of interest along the coast, in the shipyard, and among the yachtsmen are taken up. Features which are of special note are the bar and channel tables of various ports, pilot tariff, towage tariff, and port charges of ports along the Atlantic seaboard. Many interesting topics of the present day are dealt with. The subscription price is $3 a year, 10 cents for a single copy.

A TRAINING SCHOOL FOR MARINE ENGINEERS.

BY MATT. W. COLQUHOUN.

One of the most useful of the many institutions fostered by the Commonwealth of Massachusetts is the Nautical Training School. Its object is the training of young men in seamanship and marine engineering, and its home is the *Enterprise,* one of our old naval vessels, bark rigged, built of wood at the Kittery Navy Yard in 1875, of 1,375 tons displacement, speed 11 knots, with engines of the horizontal, back-acting, compound, condensing type, and developing about 790 I. H. P. The officers, who act as the instructors, are detailed for this special work by the Navy Department.

The young cadets having graduated from a two years' course in this school have a great advantage over others, for they have had training, both mentally and physically, which makes them amenable to discipline in all its phases, and frequently preference is given over those who have had many years' experience of the ordinary character. Then, again, there is a law compelling the subsidized steamer lines to carry one cadet for every 1,000 tons burden, and recently a bill was read before

THE TRAINING SCHOOL SHIP ENTERPRISE.

THE CADETS OF THE ENTERPRISE.

the Senate asking that the cadet standing first in his class be rewarded by an appointment by the President to take examination for entrance to our Naval Academy at Annapolis, the cadet standing second to be his alternate.

The qualifications necessary for a candidate are that he must have either a parent or guardian residing in the State of Massachusetts, to sign necessary papers; that he should be between the ages of sixteen and twenty, of normal size, sound constitution, and free from all physical defects. He must also pass a physical examination before the ship's surgeon, must be of good character, have an inclination for a seafaring life, and enter the school of his own free will.

SUNDAY AT SEA—AIRING LOCKERS.

The young man, having shown the necessary qualifications, is now a cadet and may elect the class in which he wishes to receive instruction, Seamanship or Engineering. During the winter term, when the old boat is snugly tied up at her berth in Boston, the cadet receives instruction in engineering, English, mathematics, hygiene, and electricity. In spring, however, he lays aside his books for the practical side, for about the first of May the ship is prepared for sea for her annual cruise in foreign waters.

After rigging ship, sails bent, and provisions stored, the *Enterprise* sails on a trial cruise which usually lasts a week and extends as far as Gloucester, Marblehead, and Massachusetts Bay, steaming about, allowing the cadets to become acquainted with their respective duties, and then at last the long-looked-for day of sailing for a foreign shore is here.

Once outside Boston Light, should there be a fair wind, engines are stopped and sails set, propeller uncoupled and left to drag; and it is here that the cadet electing to receive instruction in the engineering department has the advantage, as he also turns to and learns seamanship with his fellow seaman cadets, both standing deck watch and furling sail, but ever ready, when word is passed, to take watch below and take his first lesson in coal heaving and cleaning bilge, but soon advancing to the positions of fireman, water tender, oiler, platform, and dynamo room.

The cadets are divided into three watches, the cadets in a watch having their respective stations, together with a few older men who act as instructors.

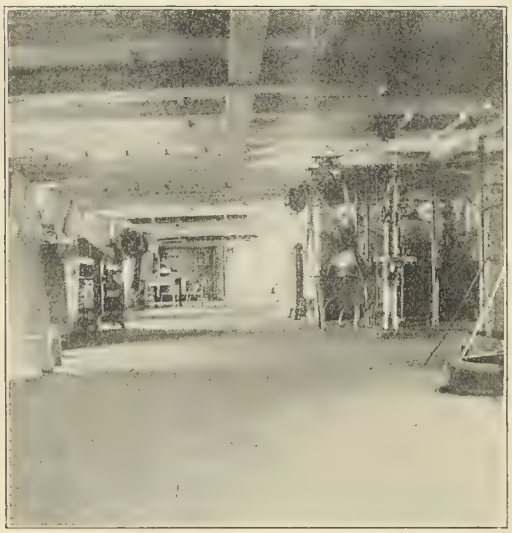
During the watches the cadets are instructed in the following: Practical work in running engines and pumps; taking and working out indicator cards and calculating slip; adjustment of parts of machinery, examination, care, and repairs of machinery; packing and making joints; pipe fitting; care of boilers when not under steam; preparing boilers for use; firing and maintaining steam; tending water; taking saturation of water in the boilers; methods of reducing saturation and preventing deposits of scale; circulation of water in boilers; use of distillers and evaporators and auxiliary engines; mechanics; electricity; magnetism; light; heat; working in wood and iron; mechanical drawing; compound, triple, and quadruple expansion engines; wiring for electric light; running dynamo and care of the electric plant; positions and use of valves, lead, and use of all pipes. But then the life of the cadet is not all work, for when in port each cadet is allowed shore

ON THE LOWER TOPSAIL YARD.

leave, one watch ashore each day, and special permission may be granted for a longer leave of absence when in such ports as Queenstown, Leith, Southampton, London, Antwerp, Havre, Stockholm, Copenhagen, Lisbon, Gibraltar, Tangiers, and Madeira, thus affording the cadets a grand opportunity of seeing the world.

The last foreign port of call is usually Funchal, Madeira; and Madeira may appropriately be called the "Garden of the World," for there abound lofty mountains, radiant with varied vegetable growth, and cut by deep gorges and ravines where rushing torrents once probably had their beds. On these mountains, as far as the eye can reach, are vineyards from whose grapes the finest wine is made; lemon and palm groves, fig trees and tropical gardens cover the mountain sides. Every-

where the air is laden with the perfume of flowers. It is customary for natives and visitors to this island to ascend these mountains on horse or mule back, and descend on sledges which are made for the purpose. The boys ascended the mountains for 2,000 feet, from whence a magnificent view could be obtained of the surrounding



GUN DECK AND MACHINE SHOP.

peaks, town, and ocean. The day of leaving for home is one generally never to be forgotten; the homeward-bound pennant is broken out, the bugle sounds, all hands on the catfalls, and at the word "Hoist away"

VIEW ON THE SPAR DECK.

the old anchor comes up as never before, and with Funchal fading away in the distance, course is laid southwest for the trades. Then for forty days we sail with nothing but the monotony of drill, broken perhaps by an occasional hurricane, for when abreast the Bermudas wind began to rise; there were frequent squalls, short and violent, with much rain, and every indication of a hard storm. The wind rapidly became stronger, and soon the storm, or West Indian cyclone, was upon us in all its violence. We ran before the gale under goose-wing topsails, fore storm staysails, wing topsails, and storm spanker; the ship was then hove to, oil poured upon the waves to quiet them, but before the gale abated much damage was done. Several boats were broken, machinery disordered, and considerable loss by sails being carried away. The ship rolled badly, the sea ran very high, and at times it seemed that the towering columns of water would crush the ship, but she rode the waves beautifully and in safety. All such experience, however, only tends toward making a cadet an efficient seaman or engineer.

CADET ENGINEERS ASHORE IN LONDON.

Boston Light is always a welcome sight to the boys three months away from home and forty-five days out from Funchal. Then, with the ship once more in winter quarters, exercises are held and diplomas are given those completing their two years, and to the rest a long-looked-for two weeks' vacation, after which they return once more for a winter term of study. Thus the boys in the State of Massachusetts have an opportunity for the study of both theoretical and practical engineering, and, once through such a training, are well qualified to pass examinations for the Revenue Service, Annapolis, or to be a cadet on a subsidized steamer.

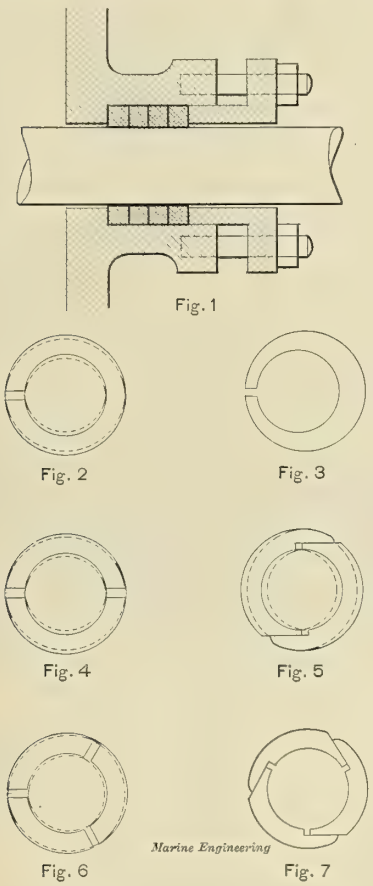
Commander Edward D. Taussig, U.S.N., is to be the new commander of the training ship *Enterprise*.

Wages of Chinese Sailors.—The United States Commissioner of Navigation, Chamberlain, has stated that, in comparing the wages paid the Chinese sailors on board four American vessels plying on the Pacific with the wages paid sailors on the *Kaiser Wilhelm der Grosse*, he finds that the average wages received by the Chinese is $21.28 per month, while on the *Kaiser Wilhelm der Grosse* it is $15.43.

OBSERVATIONS ON METALLIC PACKING.

BY C. G. ROBBINS.

Prof. R. H. Thurston showed, by a number of experiments made some years ago, that the frictional resistance of various steam engines tested amounted to 10 per cent. and upward of the rated horse power. Further experiments on the distribution of the friction showed that the greatest loss, amounting to one-third or one-half of the total friction, occurred in the main bearings; while the next important loss was the friction of the piston and piston rod, amounting, in the smallest instance, to about 21 per cent. of the total



RINGS FOR METALLIC PACKING.

friction. Of this amount about one-third, or six and one-half per cent., of the total was chargeable to the friction of the piston and rings against the cylinder walls, leaving about 14 per cent. of the total friction chargeable to the stuffing box of the piston rod.

The engines tested were of small size, and the stuffing boxes were of the ordinary type, packed with fibrous packing compressed by a gland. It is noticeable here that the packing of the piston, although of large diameter and subject to full boiler pressure, consumed only about one-half as much power as the stuffing box of the rod, although the latter is of much smaller diameter and is subject to no greater pressure. This excessive stuffing-box friction is undoubtedly due to the use of fibrous packing, which must be compressed tightly against the rod to prevent leakage.

Since the friction of the metallic packing rings of the piston, which were effective in preventing leakage, was only about one-half that of the stuffing box, it appears that the use of some form of metallic rod packing in the latter would reduce its friction in at least the same proportion, causing a gain in this case of about three-quarters of one per cent. of the rated horse power. If this distribution of the internal friction holds good in the larger sizes of engines, the question of the power required to overcome such friction is clearly a matter of some considerable importance.

Take the case of a 1,000-H. P. engine with the high mechanical efficiency of 92 per cent.; the friction load is then 80 horse power, 14 per cent. of which, chargeable to a fibrous-packed stuffing box, is practically 11 horse power. If only one-half of this may be saved by the use of metallic packing, a clear gain of over 5 horse power is assured. This will produce large returns on any reasonable investment in metallic packing, to say nothing of the longer life and less cost of maintenance.

This leads to a comparative study of the theories of fibrous and metallic packings and the determination of the reasons for the increased efficiency of the latter. The ordinary stuffing box for fibrous packings consists of a chamber on the cylinder head surrounding the rod and provided with a gland, usually arranged to be drawn into the chamber by bolts, as in Fig. 1. The box is partially filled with rings of soft or fibrous packing cut in proper lengths to neatly encircle the rod. This packing is elastic, so that when it is compressed in one direction it expands in the other; and the screwing down of the gland thus forces the rings outward against the inside of the box and inward against the surface of the rod. When properly adjusted, the steam pressure is admitted to the inside of the cylinder, the rod is moved slowly to and fro, and the gland is screwed down until steam ceases to blow through, thus adjusting the packing under the conditions of pressure, temperature, and movement under which it has to work. Even under these conditions it is evident that the packing must be set very tightly against the rod to prevent leakage, and that considerable force must be exerted to pull the rod through the packing. But the most serious defect of this style of packing lies in the fact that the operator does not always set up the packing under working conditions; nor does he cease screwing down the gland when the leak is stopped, but sets up the packing as tightly as possible when cold, and thus grips the rod with much unnecessary force.

Contrary to fibrous packings, the rings of metallic packing are not elastic, and compression in a direction parallel to the rod will not cause them to bulge or expand toward the rod. Some other means must be found to allow them to adjust themselves to the surface of the rod. This is almost invariably done by cutting the ring into segments and leaving a slight clearance between the ends. The evenness with which the rings press against all parts of the circumference of the rod will depend in a measure upon the number of segments and the lines upon which they are divided.

In Fig. 2 is shown a plain concentric ring cut in one place only. Pressing the ends of the cut together would evidently cause the ring to assume something of the

shape shown by dotted lines and to grasp the surface of the rod unevenly. Possibly a ring of the shape of Fig. 3 could be made to contract more in conformity with a true circle. But even if this could be done, it is necessary to cut the rings in at least two parts to avoid disconnecting the rod for renewals.

The next evident step is the division of the ring into halves, as in Fig. 4. Assuming the rings to be inflexible, the pressure of the rings against the rod will bring them into the position shown in dotted lines; the most wear will take place at the top and bottom, and the rings will adjust themselves, by wear, very closely to the contour of the rod. Another method, sometimes used, of dividing the ring into halves is shown by Fig. 5; this answers the same purpose as Fig. 4. The next step is the division of the ring into three parts by cuts radial to the rod. Fig. 6 shows this arrangement, and the dotted lines show the movement inward and the nature of the wear necessary to allow them to accurately fit the surface of the rod. Fig. 7 shows another three-segment ring divided in a different manner.

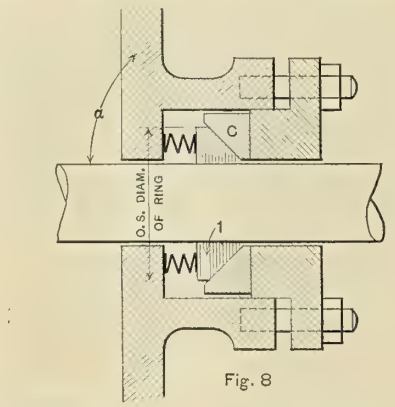
All these arrangements, except the first, are in common use among the manufacturers of metallic packings. Since in every case the rings are cut in at least two places, through either of which steam might blow while the remainder of the rod circumference was tight, it is evident that the rings must be in pairs and arranged to "break joints," the second ring packing or covering the joint in the first. This is always done, and usually their relative positions are fixed by dowel pins fitting into holes in the adjacent rings.

We have seen how the rings are arranged to enable them to grasp the rod with some force and to move inwardly against its surface as wear takes place. Metallic packings are always arranged to automatically adjust themselves, and it will be interesting to see how this is done. Broadly speaking, there are two general methods of holding the rings to the rod. The first is by means of sliding surfaces inclined at an angle to the axis of the rod and down which the rings slip. This method may or may not involve the use of springs acting parallel to the rod.

The second method is by the direct action of an encircling or sphincter spring, usually of coil shape, or by other exterior springs pushing toward the rod centre. A few packings really belonging to this second class use the encircling spring merely to hold the rings in position, and depend upon the steam pressure, which is allowed to get behind the rings, to hold them to the rod.

Fig. 8 shows diagrammatically a packing of the first class, using inclined sliding surfaces and springs to adjust the packing to the rod. The packing rings are forced into the cone as wear takes place, contracting their outer diameters and gradually closing up on the rod, as shown by dotted lines in the previous illustrations. It is evident that the steam pressure is free to act on the back of ring 1, and that the force pushing the rings into the cone is made up of the constant pressure exerted by the springs and the mean effective pressure of the steam in the cylinder. Assuming that there is no friction between the cone and the outer circumference of the rings, it is evident that by the simple force polygon of Fig. 9 we can find the pressure with which the rings grasp the rod. All that is necessary is to draw the line AB proportional by scale to the force pushing the rings into the cone; the line AC parallel to the inside surface of the cone or sliding surface; and the line BC at right angles to AB; then BC measured by the scale to which AB is drawn will give the force grasping the rod. If now we know the coefficient of friction between the rod and the packing, we can calculate the pull necessary to slide the rod through the packing. This pull multiplied by the piston speed in feet per minute will give the foot pounds of energy required to overcome the friction of the packing; and this divided by 33,000 gives the horse power lost in the box.

Take the case of the 1,000 horse power cross-compound engine previously mentioned, in which the initial steam pressure will be taken at 160 pounds, the piston speed at 750 feet per minute, each piston rod at 4 inches diameter, and the mechanical efficiency at 92 per cent. Then the friction of the fibrous-packed stuffing boxes amounts to 11 horse power, on the basis of Thurston's experiments. The probable maximum friction of metal-



INCLINED SURFACE METALLIC PACKING.

lic-packed rod boxes may be found as follows: The outside diameter of packing ring 1, Fig. 8, will not be over 6 inches, and the area upon which the steam pressure acts will be the difference between the areas of a 6-inch and a 4-inch circle, or 15.6 square inches. The mean effective pressure in the high-pressure cylinder is about 60 pounds, and if we assume the springs to exert a constant force equal to 40 per cent. of the initial pressure, or 64 pounds per square inch, the total pressure acting on the back of ring 1 is $60 + 64 = 124$ pounds per square inch. Then the total pressure AB, Fig. 9, tending to force the rings into the cone, is $15.6 \times 124 = 1{,}934$ pounds. If the angle of the cone is 45 degrees, as is not uncommon, the force polygon of Fig. 9 shows that the pressure against the rod is also 1,934 pounds. If we assume a coefficient of friction of 3 per cent., the force required to pull the rod through the packing is

1,934 × .03 = 58 pounds. At 750 feet piston speed, the power exerted is 58 × 750 = 43,500 foot pounds per minute, amounting to 43,500 ÷ 33,000 = 1.32 horse power. Taking the low-pressure cylinder at the same amount, we have 2.64 horse power for the friction of the piston rods, or about one-fourth that of the fibrous-packed boxes. When the rings are held to the rod by encircling springs, as in Fig. 10, or by the steam pressure acting on the outer circumference, it is more difficult to find the pressure against the rod. The tension of the springs and the area of rings exposed to the steam pressure must be known. The pressure is probably about the same as in Fig. 1.

In any case it seems plain that the friction of metallic packings will be materially less than that of fibrous ones. The rings being of metal can be finished, and will wear, to a practically perfect fit on the rod, and so require only a comparatively light pressure to make a steam-tight joint, while the highly polished surfaces quickly acquired will reduce the coefficient of friction to a minimum. On the other hand, the fibrous rings cannot, on account of the nature of the material, be fitted so accurately to the rod nor acquire so perfect a polish; nor do they, as a rule, automatically adjust themselves to wear, but must be compressed by the gland, so that their natural elasticity, or expansion, compensates for wear. All this tends toward an excessive pressure against the rod, with a corresponding increase in friction.

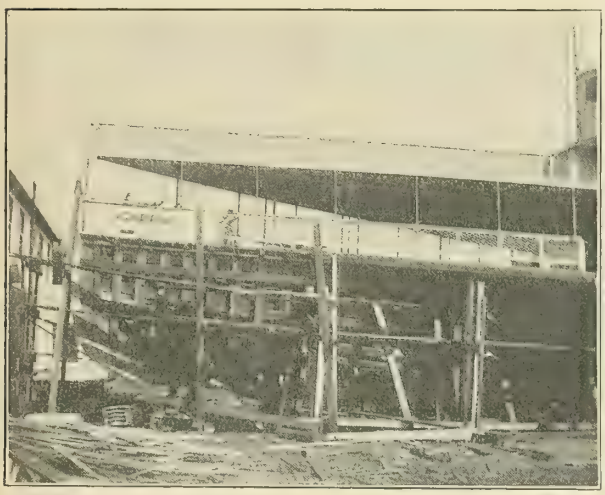
Harvard Engineering Journal.—Beginning with April, the first number of a journal devoted to the interests of engineering and architecture, and called the *Harvard Engineering Journal,* was published at Harvard University. It is a well-printed journal of 80 pages, and in the first issue appear articles upon engineering at Harvard and a description of the Steam Loop and Holley Gravity Return system for boiler plants. The subscription rates are $1 per year in advance and single copies 35 cents. All communications should be addressed to the *Harvard Engineering Journal,* Pierce Hall, Cambridge, Mass.

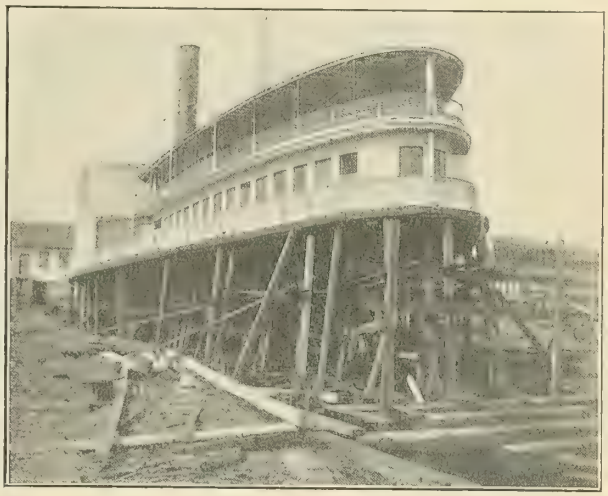
Building a New Hull for an Old Boat.

Something quite out of the ordinary line of vessel building and repairing was to be seen at the yard of the Robert Palmer and Son Company, Noank, Conn., where hauled out on one of the railways was a paddle-wheel craft about 200 feet long.

The framework of this vessel was sadly in need of repair—that is, if the fragments of the old timbers are anything to judge from—but the upper works were in good condition, and for this reason it was suggested by the owners that it would be advisable to have a new hull built, leaving at the same time the upper works intact.

Uprights were therefore placed so as to take the strain of the superstructure from the hull, which was then cut into and removed in sections, care being taken that the model of the old hull should be reproduced in the new framework; for though the boat is an old one, the shape of the hull was considered good. The engines and boilers are still in her and were not removed, but simply raised sufficiently to admit of putting underneath them the keel, frames, etc. A keel was laid and frames erected, just as though a new vessel were being built, but great care had to be taken to see that everything coincided, as there were obstacles to be overcome that would not occur in a vessel built in the usual manner.





BOW AND STERN VIEWS OF THE NEW HULL BUILT UNDER AN OLD BOAT.

As can be seen from the photographs, everything from the main deck upwards is standing, even to the smokestack and short masts, and the uprights supporting the upper works are clearly discerned. The engine bed has been replaced by a new one, and in fact all the interior work of this craft will be new. The tanks which were situated alongside the engine were removed and are now aft of the same, but will eventually be placed in their original position.

All of the deck beams are in good condition, but at intervals there are placed beams of yellow pine 10 by 12 inches, which will add considerably to the strength.

When finished the boat will be much stronger than originally and will be a fair sample of what can be done in these days of advancement.

AN EXPERIMENTAL ELECTRIC LAUNCH.—I.*

BY PROF. OSWALD FLAMM.

The many attempts which have been made to utilize electricity for the propulsion of boats have not on the whole met with the success which had been anticipated. While, indeed, high propulsive efficiencies were realized, yet the practicable speed, the radius of action and other peculiarities were far from satisfactory. The chief difficulty in connection with such boats lies in the small weight efficiency of the propulsive equipment with its accumulators and motor, and in the fact that in this respect the naphtha and various forms of petroleum motors, as well as the steam engine, all show a decided superiority. It should, however, be admitted that the electrical engineer has thus far given but slight attention to the conditions and requirements of a motive equipment for marine propulsion, and that for the most part he has been concerned with types of construction suited for stationary service, but which by reason of their large dimensions and weight are not suited for the propulsion of boats.

A like relation exists to-day between the steam engine for stationary service and the best types of marine engine, and as the designer and builder of the latter have been able to produce an engine of maximum output for minimum size and weight, so must the electrical engineer, if he wishes to provide for boat propulsion a suitable equipment, devise means for vastly increasing the output for a given weight of electrical equipment, in comparison with conditions as they now are. It may be in fact pointed out that in these particulars notable improvements and advances are not only possible but probable. Should the problem of electric propulsion for boats be again undertaken, an effort should be made to enlist the warmest coöperation between the boat builder and the electrical engineer, so that while as regards the boat every advantage may be taken of modern advances the better to adapt the boat to the purpose in view, so also the electrical engineer may, more perfectly than hitherto, adapt the means at his disposal to the same ultimate purpose.

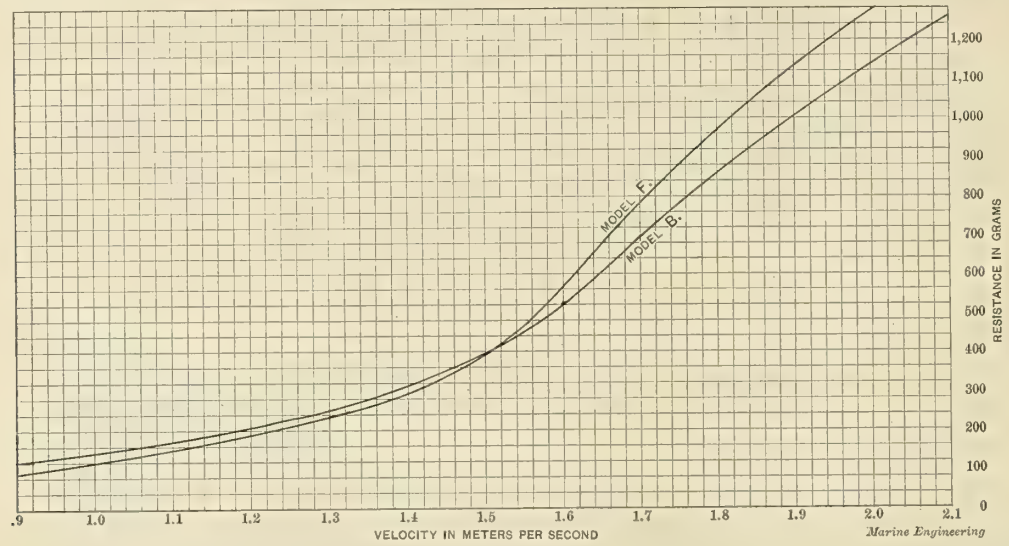


FIG. 1.—COMPARATIVE RESISTANCES OF TWO MODELS.

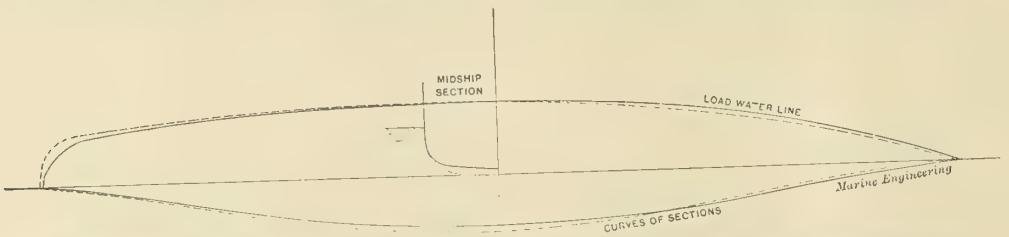


FIG. 2.—LOAD WATER LINES AND CURVES OF SECTIONS OF THE TWO MODELS; MODEL B IS IN DOTTED LINES.

When one considers the many valuable features which an electrical propulsive equipment possesses, so is one filled with the desire to realize them in marine practice in so far as conditions will possibly permit. Even aside from the fact that an electric boat furnishes unobstructed deck and cabin room for the use of those on board, the nautical qualities of such a boat provided with storage battery, may by a suitable disposition of the latter be modified in such manner as desired. Furthermore, the operation is clean and simple, and in localities where charging stations are at hand or where they may be readily reached, electric propulsion for certain purposes will doubtless increase in favor.

With these various points in view, the Watt-Accumulator Works in Zehdenick, on the Havel, built last year an experimental electric boat. The electrical equipment,

*Translated from Schiffbau, February 8, 1902.

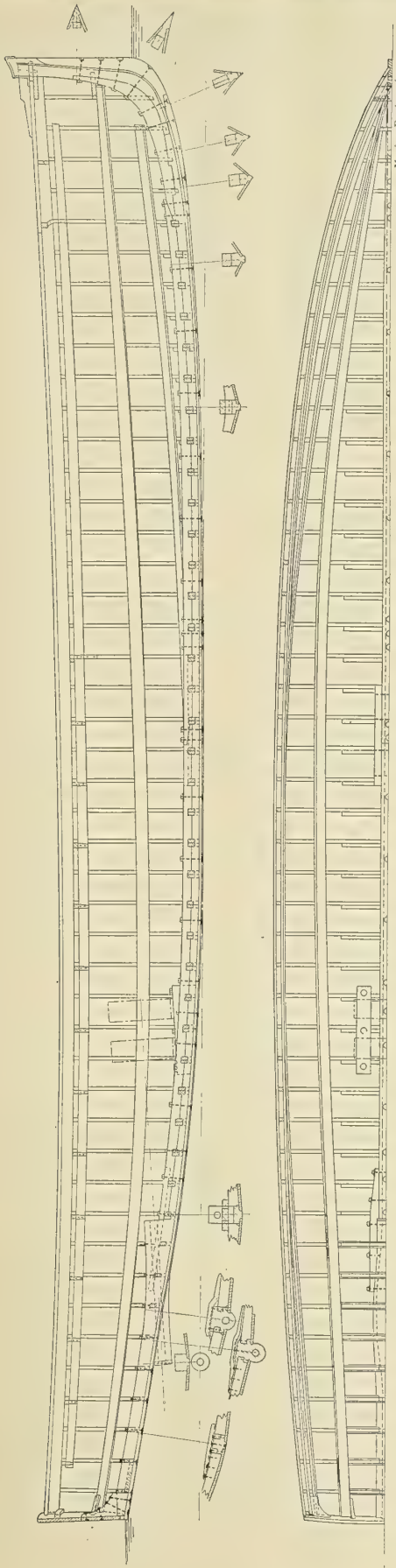


FIG. 3.—LONGITUDINAL AND DECK PLAN OF EXPERIMENTAL LAUNCH.

as well as the construction of the boat, was undertaken by the above named firm; while the technical features of the boat, as well as of the propeller, were undertaken by the writer. The boat was completed in the autumn of 1901, and has since then undergone numerous trials in Stettin, also from Swinemünde to the open water, and later, on the Tegeler See near Berlin. A report of the results of these trials will perhaps possess some interest.

For the form and dimensions of the boat two designs were prepared as follows: Design B was 52.5 ft. in length on the water line, 8.2 ft. in width outside the planking, 2.62 draft midships, with a displacement of 17.3 tons in fresh water. Design F had the same length and beam, a draft midships of 2.95 and a displacement of 18.3 in fresh water. Smooth wooden models to a

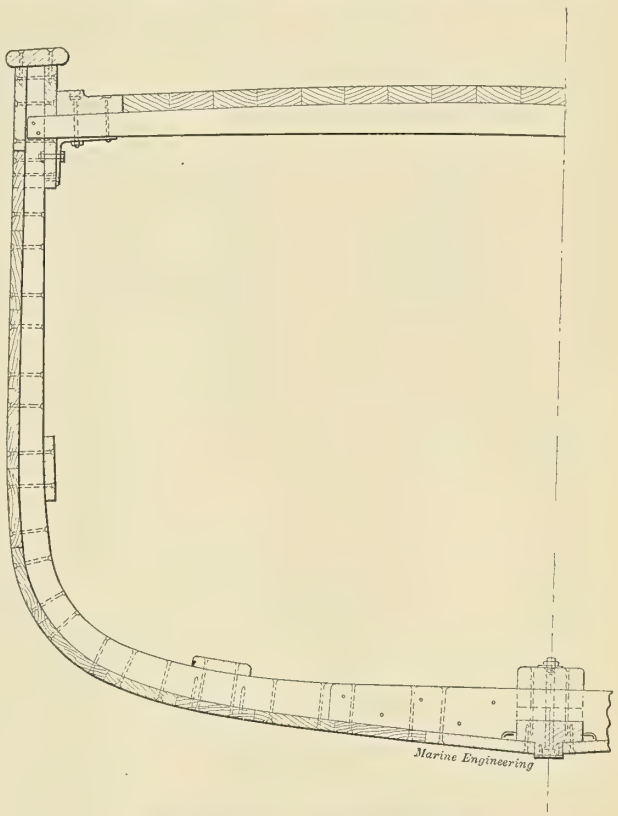


FIG. 4.—MIDSHIP SECTION OF LAUNCH.

scale of 1 : 10 were made of both designs and tested at Bremerhaven in the experimental tank of the North German Lloyd Co., with regard to their resistances at various speeds. The results of these tests are shown in the diagram of Fig. 1. The construction water line, curve of section and form of midship section for each design are found in Fig. 2. A number of wave photographs for each boat at varying speeds were made at the time of trial. One of the most interesting results of these tests is found in the relative influence of skin resistance and form resistance, which is clearly shown by the curves in the diagram of Fig. 1. With model B having a finer form forward, but greater wetted surface, although with a 6 per cent. smaller displacement, at low speeds for which the form resistance was not of so great importance, the resistance was greater than that for model F with less wetted surface, greater draft and

greater displacement as stated. As the speeds were increased above 295 feet per mt., corresponding to 9 1-2 knots for the boat, the superiority of model B over model F, due to its better form for high speed, became plainly apparent. It yet remains to determine whether it is possible under existing conditions to supply sufficient electric power to drive the boat at a speed above 9 1-2 knots, and thus realize the superiority of the form of model B. On the other hand, however, the question of the radius of action of the boat at moderate speeds was of importance, and for these conditions the form of model F was sensibly better than that of model B. In consequence a new design was prepared intended to unite the superiority of model F for the low speeds with that of model B for higher speeds. The actual boat

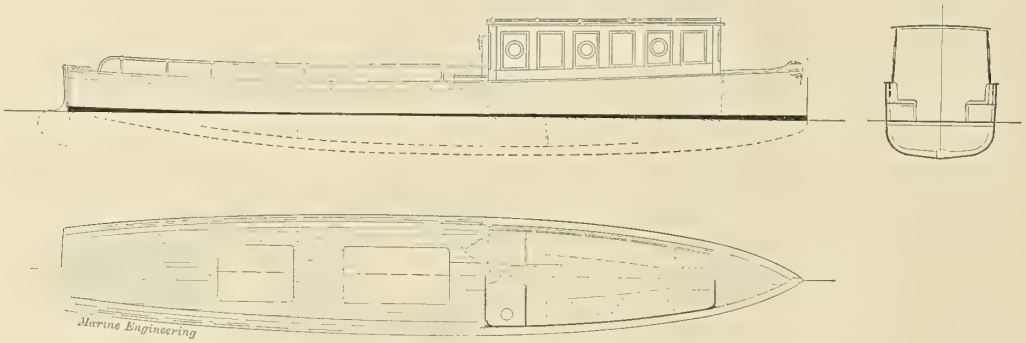


FIG. 5.—GENERAL ARRANGEMENT PLANS OF EXPERIMENTAL LAUNCH.

was built in accordance with this model, and of the following dimensions and particulars.

Length on the water line	52.8 ft.
Beam on the water line	8.2 ft.
Draft amidships	2.62 ft.
Depth	5.09 ft.
Displacement	17.5 tons.

The metacentric height as determined by the usual inclining experiment was found to be about 1.31 ft.

The boat was built of wood, the frame of the best oak, the keel and sheer strake of oak, the remaining planking of yellow pine. A smooth continuous deck of yellow pine was fitted, and the water ways were made of oak. The usual stringers and tie pieces were also fitted as shown in the section. The general plan of the boat is shown in Fig. 3, the structural section in Fig. 4, and the deck plan and profile in Fig. 5.

(To be continued.)

U. S. Coaling Station, Frenchman's Bay, Maine.

The site selected is ideal for its purposes. The Government owns about sixty acres, having a water front of a third of a mile. Eastern Bay affords a safe anchorage for a large fleet, and the islands near the entrance make it almost impregnable to attack when fortifications are erected, as they will be when the entire scheme is carried out. In time of war the station would be the principal base for practically the entire New England coast as far west as Boston.

The main building at the station will be a granite and steel coal house, with a storage capacity of 10,000 tons. There will be a steel coaling pier 400 feet long and 48 feet wide, the front face of which is in thirty feet of water at extreme low tide.

As there is a heavy rise and fall of the tide in the bay, the problem of constructing a pier for the use of large ships was a difficult one. This has been met by driving steel pipe piling clear to the rock and filled with concrete, braced and capped and decked over, which makes the steel pier superior to any other now built.

On the pier are two powerful steel traveling towers that pick up the coal from colliers and dump it into cars that run on tracks into the monitor of the coal house, until at a proper place they discharge their loads into the house proper.

When a vessel is to be coaled cars are run on the tracks underneath the storage floor of the coal house, and by means of valves, the floor above is opened at numerous points, and the coal comes running down into the cars, which then continue their journey through the tunnels, and the coal is discharged into the waiting man-of-war.

The whole process of receiving coal from colliers into the house and delivering it from the house to vessels is practically mechanical, and requires little hand labor. There is an endless chain of cars running in each direction, and worked by the powerful machinery. From 100 to 150 tons can be loaded or unloaded every hour.

The danger most feared in all large coal piles is spontaneous combustion, and to prevent this unusual precautions have been taken. The coal house is divided into sections by massive cross walls, so that should fire break out in one section it can be confined to its place of origin and prevented from spreading. The house is completely equipped with apparatus that will instantly record any rise of temperature, which will give timely warning of fire.

Besides being a coaling station a water system will be erected by which ships can be provided with fresh water for steaming purposes, and the grounds of the depot will be prepared for the use of crews for drilling and small arms target practice.

When completed the new depot will cost $250,000. The contractors expect to turn it over to the Government during the coming season.

Japanese Ship Combine.—For preventing the Atlantic shipping trust from obtaining control of the traffic interests of the Asiatic coast, eleven Japanese steamship companies have formed a steamship combine, with headquarters at Osaka, Japan.

CARE AND MANAGEMENT OF THE MARINE GASOLINE ENGINE.—II.

BY E. W. ROBERTS.

The methods of supplying fuel to a gasoline engine may be divided into three classes. The first or older method is known as the carbureter system, and consists of enriching the ingoing air or a portion of it by evaporation of the gasoline. This is accomplished by passing the air either through or over a large body of the liquid. This divides carbureting systems into two methods: the first, in which air is passed through the fuel, giving the filtering carbureter, the other method being that of the surface carbureter.

CARBURETERS.

An example of the filtering carbureter is shown in Fig. 7, the principle only being illustrated. Air is drawn

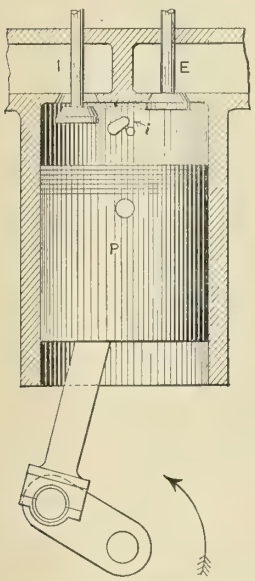


FIG. 1.—SUCTION.

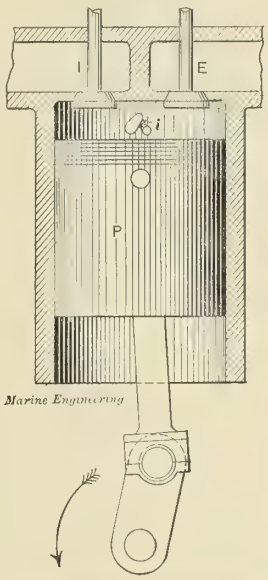


FIG. 2.—ENDING COMPRESSION AND IGNITING.

KEY FOR TWO AND FOUR-CYCLE TYPES, FIGS. 1, 6:

I = Inlet.	D = Deflecting Plate.
E = Exhaust.	C = Check Valve.
P = Piston.	J = Jacket.
K = Crank Case.	i = Igniter.

to the engine through the pipe a, the vacuum formed in the tank causing air to enter through the pipe b and to bubble up through the body of the gasoline, evaporating a portion of the fuel, which makes a rich mixture of air and gasoline vapor. As the air carries with it particles of gasoline held in suspension and still in the liquid state, it is necessary to use a sheet of wire gauze, g, to act as a separator, so that only gasoline vapor and air pass out through the pipe a to the engine. Several layers of gauze, g^1, are usually inserted in a in order to prevent flame from striking back into the carbureter in case of a backfire through the inlet valve.

A surface carbureter is illustrated in principle in Fig. 8; air entering at b, passing over the various partitions w, and beneath the partitions p, so that the air is compelled to pass quite closely to the surface of the gasoline in the bottom of the tank, finally leaving at a on its way to the engine. The surface of the liquid is often increased by attaching wicking to the partitions w, as indicated in the figure. Quite frequently the partitions w are laid in the form of a spiral extending to the top of the tank, the air entering at the centre and passing from the carbureter at the outer end of the spiral, as indicated in Fig. 8A. In some forms, a portion of the exhaust gases are passed through a pipe in the bottom of the tank in order to accelerate the evaporation.

Carbureters are very little used at present, being supplanted by the more efficient and less dangerous vaporizer. Carbureters evaporate the lighter portions of the fuel, leaving a residue which must be thrown away. They are also affected by changes in the atmospheric conditions, as any increase in the humidity of the atmosphere would decrease the evaporating power of the air. No amount of wire gauze will prevent the flame

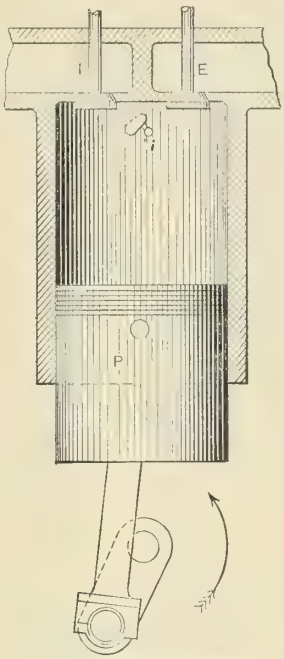


FIG. 3.—EXPANSION.

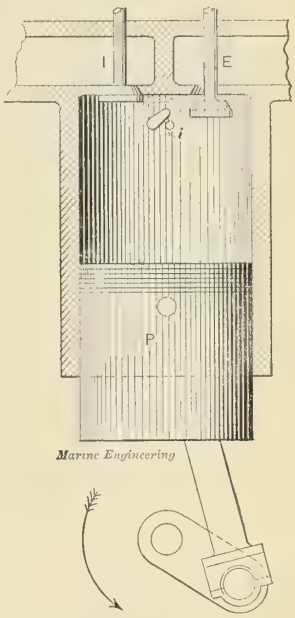


FIG. 4.—EXHAUST.

from occasionally striking back into the tank, and if the vapor and air is in the right proportion the carbureter will explode, usually with disastrous results. It is necessary to add air to the mixture from the carbureter, as it is generally too rich to give the best results, and in extremely cold weather it is quite often a difficult matter to get the carbureter started without warming it, this being a dangerous proceeding unless it is done with a moderately heated substance, such as hot water.

VAPORIZERS.

The second method of supplying fuel to the engine, and that in most general use to-day, is the vaporizer. Properly defined, the vaporizer is a device for supplying fuel to the air in just the quantity needed, and while the air is passing to the engine, the vaporizer being operated by the action of the air itself as it passes through it. In other words, the liquid gasoline flows into the air as it passes through the vaporizer, and is usually first thrown into spray and then thrown into vapor by being dashed against the walls of the inlet pipe. The reader is asked to note carefully the distinction made between the car-

bureter and the vaporizer, as there is much confusion between these terms, especially in literature relating to automobiles.

In Fig. 9 is shown what the writer believes to be the simplest form of vaporizer he has seen, and which illustrates the principle involved. The pipe *a* represents the inlet passage to the engine through which the air must pass. In it is inserted a pipe, *b*, connected with a constant-level reservoir of gasoline standing just below the top of the pipe at *b*. The suction of the air passing by *b* carries gasoline with it, the quantity of fuel being determined by the opening of valve *v*. To the average gas-engine builder this would look like a device too simple to work well, and probably would not answer for a boat; but it is a very successful device for a stationary engine, as the writer has seen the actual arrangement shown in practical operation.

Another very simple form of vaporizer is shown in Fig. 10, and consists of a check valve with a hole, *K*, in the seat of the valve *E*, through which the gasoline enters whenever the air passing through it opens the valve. The valve is held to its seat by a light spring, *M*, and the valve gives very little resistance to the passage of the air which enters at *C* and passes to the engine through the opening *X*. The flow of gasoline is controlled by the needle valve *F*, the pointer *G* serving to indicate the opening. The vaporizer is connected to the gasoline tank by a lead pipe leading from the opening *O*. In this vaporizer the gasoline being inclined to flow around the valve seat *E*, it mixes well with the ingoing air, and at the end of the compression stroke it is quite thoroughly diffused and makes a very good mixture.

There are quite a number of variations of the two fundamental types shown, Fig. 9 being varied by means of a long nozzle leading into a vertical air pipe. Variations of Fig. 10 are produced by adding a point to the centre of the valve *E*, making it double-seated, and the point closing the gasoline inlet. The principle, however, is the same. In other variations of this form the valve *E* becomes a mere disc which acts as a baffle plate to open a small needle valve leading to the gasoline supply. The valve shown in Fig. 10 is sometimes used as a check

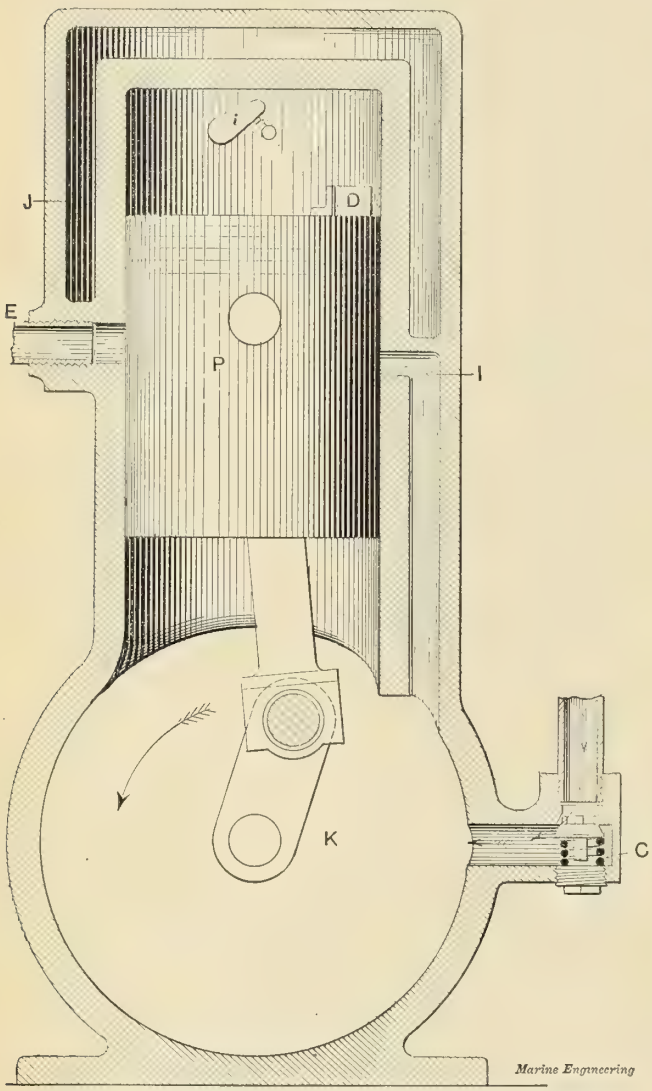


FIG. 5.—TWO-CYCLE ENGINE, NEARING END OF UPSTROKE. CHARGE COMPRESSED AND IGNITING, FRESH CHARGE ENTERING CRANK CASE.

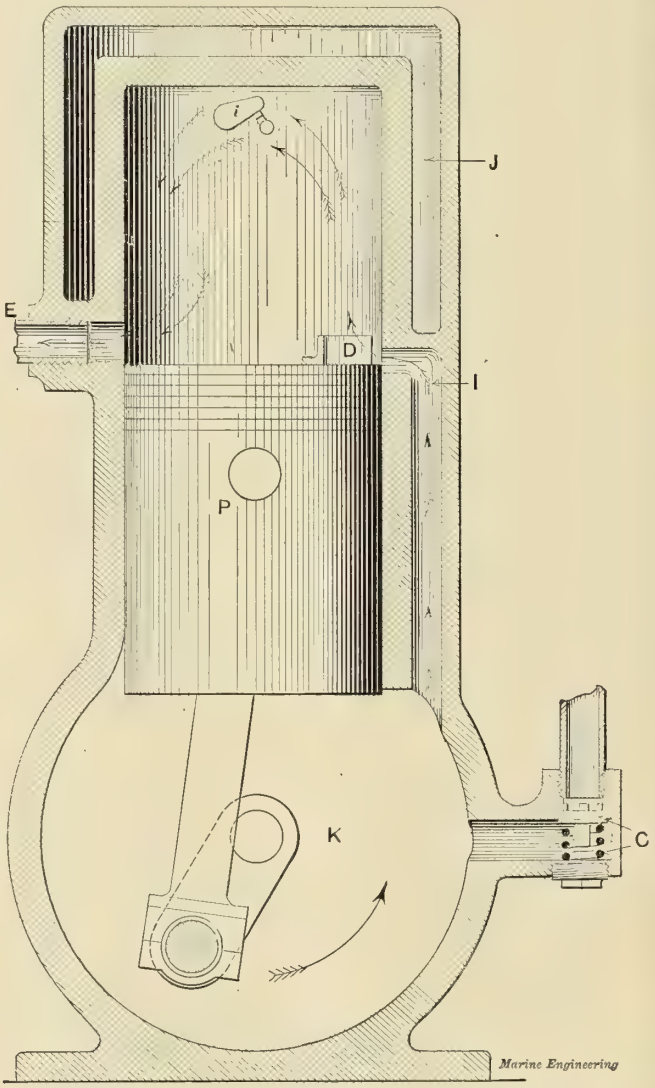


FIG. 6.—TWO-CYCLE ENGINE, NEARING END OF DOWN STROKE. EXHAUST ESCAPING. CHARGE ENTERING FROM CRANK CASE.

valve on a two-cycle engine, but experience has shown that it is better to have a separate valve for this purpose. These valves are also used quite successfully on four-cycle engines, although the form shown in Fig. 9, but having the nozzle in a vertical air pipe, is that most

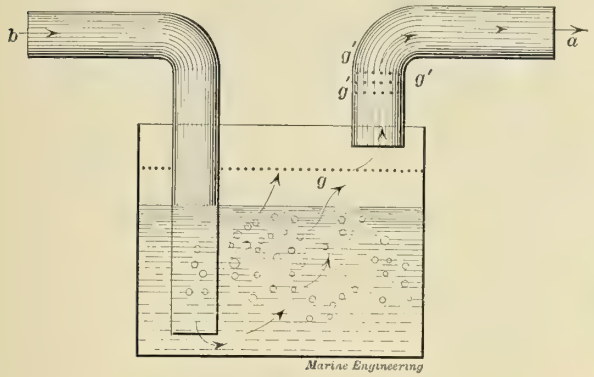


FIG. 7.

often seen in connection with the four-cycle type. The valve, Fig. 10, is quite often called a generator valve, although it really does not generate a gas. It should always be used with a short vertical pipe screwed into the

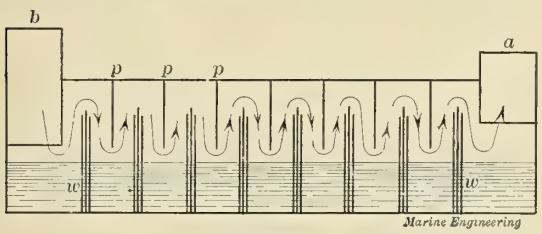


FIG. 8.

opening *C*, and also it should stand in the position shown so that the valve *E* opens in a downward direction.

It will be readily recognized by the reader that both these forms of vaporizers operate on somewhat the same

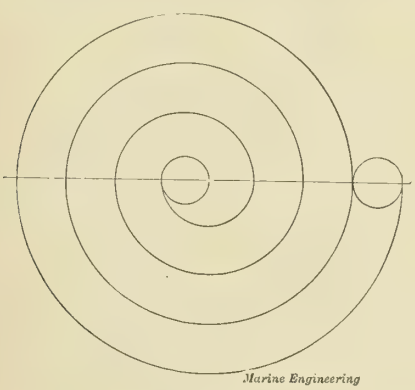


FIG. 8A.

principle as the atomizer used for perfumes. Of the two types, that of Fig. 9 is perhaps the most convenient, as the flow of gasoline always stops when the engine stops, while the generator valve will allow a small amount of gasoline to flow past the valve, and if the needle valve is not closed it will usually flood. On the other hand, a constant-level reservoir must be used with the nozzle type, else it would overflow if the stern of the boat were very much depressed.

A peculiarity of the generator valve should be noted herewith. If the engine should for any reason be speeded up, as, for instance, by increasing the lead of the igniter, the needle valve should be closed slightly, as the draft of air will be stronger. On the other hand, the valve should be given a little extra opening on starting the engine, because the draft is less than when the normal speed is attained. Sometimes starting may be assisted by depressing valve *E* with a rod or pencil, allowing a little fuel to escape into the air pipe. The opening must also be increased a little as the gasoline gets low

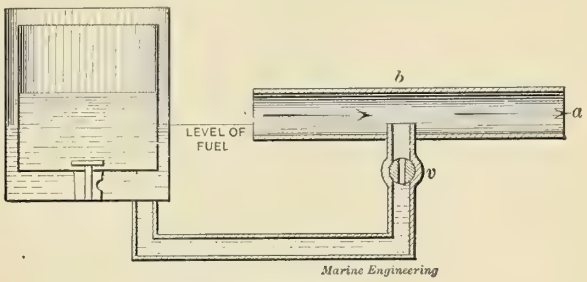


FIG. 9.

in the tank, and in small boats it will be necessary to increase the opening whenever the bow of the boat is depressed, as when the occupants go forward.

Still another form of vaporizer is shown in Fig. 11, in which a stream of gasoline is pumped continually across the air pipe *a*, as shown at *j*. Usually a part only of the air passes through this pipe, as otherwise the mixture would be too rich in fuel. There are several variations of this particular form in which the gasoline is made to flow over a piece of gauze or wicking or some other

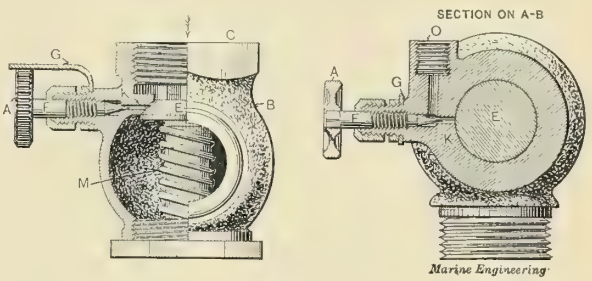


FIG. 10.

fibrous material, as cotton. This form, it will be noted, is somewhat on the order of the carbureter, but lacks its dangerous properties.

The third method of supplying gasoline to the ingoing air is known as the jet feed, and consists in the use of an extremely small pump which throws a jet of gasoline into the air pipe at the moment of induction. The pump acts independently of the suction or draft of the passing air, and is a measuring device. It is not used in marine practice, so far as the writer is aware. It is very uncertain in its action, particularly on small engines, and will not answer at all where the engine is controlled by varying the amount of the charge, as by throttling.

While on the subject of vaporizers the writer might say a few words about the throttle valve which is usually

employed for controlling the speed of a marine engine. In general it may be stated that almost any form of lever valve which can be fully opened or fully closed by a short movement of the hand will answer the purpose. It should invariably be placed between the vaporizer and the inlet valve of the engine and as close to the inlet valve as it is practicable to put it. A very convenient place for the throttle on a two-cycle engine is in the passage

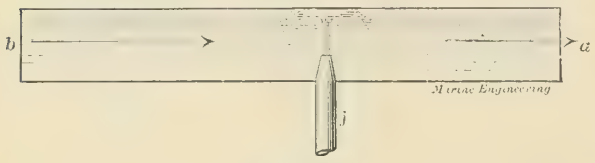


FIG. 11.

between the crank case and the cylinder. However, a good valve which controls the passage of the air into the crank case seems to answer the purpose just as well. A governor operated by the engine itself is employed by some makers, and when the speed is controlled on the hit-or-miss principle it is absolutely necessary, but for a throttle engine hand control is that most commonly employed.

(To be continued.)

REFRIGERATION ON SHIPBOARD.—III.

The Design and Operation of the Store Rooms.

BY E. N. PERCY.

Much of the inefficiency, trouble, and worry due to this class of machinery can be traced directly to the store rooms. Here is where the results of the process of refrigeration are made manifest. Here is where all of the efforts of the best machinery may go to naught if not properly made use of. If poorly designed and operated, it may be wasteful, unsanitary, unhandy, disagreeable, and positively dangerous in many ways.

The first thing about the "ice house" is its size and general arrangement. It should be large enough to carry all the provisions necessary and to allow a full circulation of air around them. In addition to this, there should be room for the brine piping, the ice tanks, and a gangway on all sides between the provisions and the wall. A very nice arrangement is to have one room for meats, another for vegetables and fruit, and a smaller anteroom for temporary storage of victuals, implements, drawn ice, and the ice-making apparatus. The piping should be as high as possible, but must be accessible for cleaning and repairing. Care should also be taken to see that it is not placed where it can drip brine or frost on the provisions. These requirements almost confine it to the sides of the rooms near the top; and here is where we usually find it in carefully designed plants for marine work. The best size and kind of piping for the brine is that which will expose the most cooling surface with a minimum of water. It must be thin to be a good conductor, yet able to withstand the corrosive effect of the strong brine. Experience and good practice indicate 1 1-2-inch to 2 1-2-inch galvanized gaspipe, with any suitable size for a manifold. The brine in the main pump discharge should not flow over 200 feet per minute, and in the cooling coils not over 50 feet per minute, and the coil should be long enough to allow the brine to absorb enough heat to raise its temperature to that of the room. Enough coils should then be provided to keep the room down to the required temperature.

Gates should be provided to close off any room, or several sections of one room, in case they are not needed. They are also convenient in rough weather, or when the ship is listed, in order to keep the brine from all going to one room. The pipes should be rigidly supported, and, while screwed fittings are the most practical, they should be substantial and the joints well made. The frost should be kept off the pipes to realize the highest efficiency. A steel scraper curving half around the pipe answers, but, for comfort and convenience, should have a long, stout handle like a large gouge.

The ice tank should have well-sealed covers to keep the brine from spilling. The can system is preferable for shipboard. A most important item in connection with the ice is an efficient, reliable tackle for hoisting the cans. Small cans, not over 40 pounds, should be used, and, if provided with means of attaching the tackle, should be easily handled in the heaviest weather without danger or inconvenience. Getting the ice out of the cans is a source of great annoyance in most plants. Either hot water has to be taken into the ice house, or the ice has to be removed to the deck to melt from the cans. A good plan is to have a steam box to hold one can at a time, and fed by a half-inch pipe from the boilers and a valve at the box. After the can is removed, a tight-fitting cover may be fitted to prevent steam escaping into the ice room.

Regular racks or chests should be provided for spare ice, as it is disagreeable to have it sliding about the floor or stored in some inaccessible corner. Great care should be taken to see that the store rooms are well drained and somewhat ventilated. The necessarily wet, slippery floors make gratings of wood or rubber a necessity. Matting is not sanitary and iron corrodes rapidly.

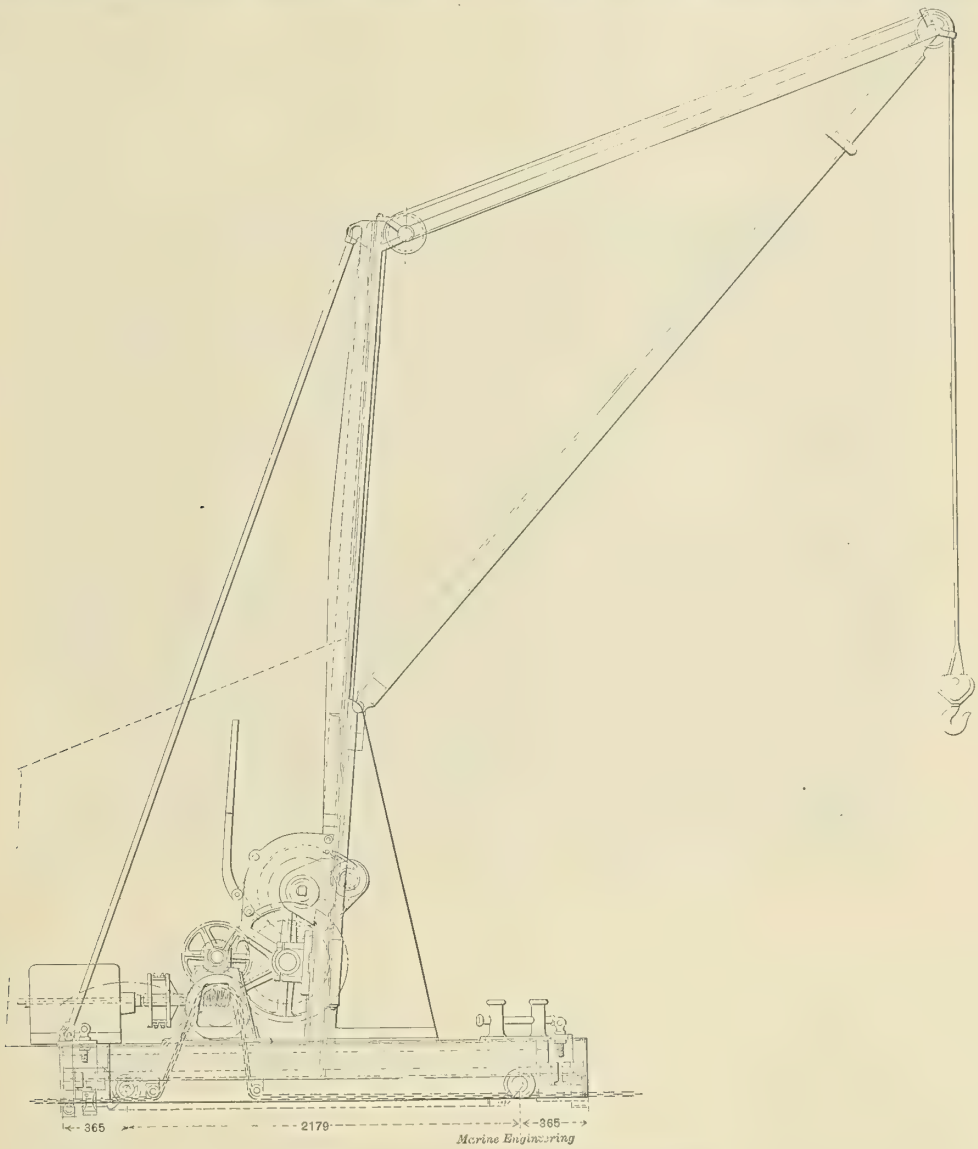
A great convenience in handling ice, provisions, water, etc., is a trolley track around the ceiling, with a trolley and pulley carrier running thereon. It is almost indispensable in rough weather, as heavy meat is very hard to handle when half-frozen. Brine should be made in a separate barrel kept in the ice house. This barrel should be about half-full of brine, and, as brine is taken out to supply waste, more salt and water may be added and the density kept constant by testing with a hydrometer. Salt should be added until it will float a potato easily, corresponding to 90° on the common hydrometer.

The ice rooms should be supplied with fresh-water pipes, electric lights, and means of rinsing down the floor. The doors should be thick enough to keep out the heat. Since they are necessarily very heavy, it is a good plan to have them well fitted with hooks, latches, and bars to hold them rigidly in any desirable position, as serious accidents may happen if they are allowed to swing. If some of these precautions could be observed, the refrigerating plant on shipboard would have a much better reputation among engineers than it now enjoys.

MODERN SHIPWAY EQUIPMENT, AND ITS FUTURE DEVELOPMENT.—I.*

BY TJARD SCHWARZ.

With the beginning of the development of iron shipbuilding, about the middle of the century, came new problems. The working of iron materials required machinery driven by steam power. The bending of frames, as well as the working of curved sheets of plating, required especial heating furnaces and arrangements. There came, therefore, the ship workshop, in which the plates and angles, partly cold, partly warm, were prepared, while at the building slip the assembling and riveting of the members followed. Here, furthermore, the separate structural members required various sorts of operations, which for the most part were carried out by hand. Also, at first, the transport of the prepared material to the building slip experienced, in comparison with wooden shipbuilding, but slight modification. The workmen carried the frames and plates, after preparation in the shops, on their shoulders to the building slip. These difficult and primitive methods of work lasted until about the eighth decade of the century, when use began to be made of cars on tracks for the transport of material, and of derricks for hoisting it to its place in the ship. The hoisting was carried on in the first place by hand, and later by means of steam winches. In the course of time the masts, with their booms, were increased to three on each side of the ship, and were operated, on account of their distance from the power station, by electrical drive. As an example, mention may be made of the electrical windlass of Blohm and Voss. This, on account of the simple change from hoisting to lowering, whereby the motor retains its direction of revolution, renders it especially suited for use about shipways.



CRANE AT KAISERLICHEN WORKS, WILHELMSHAVEN.

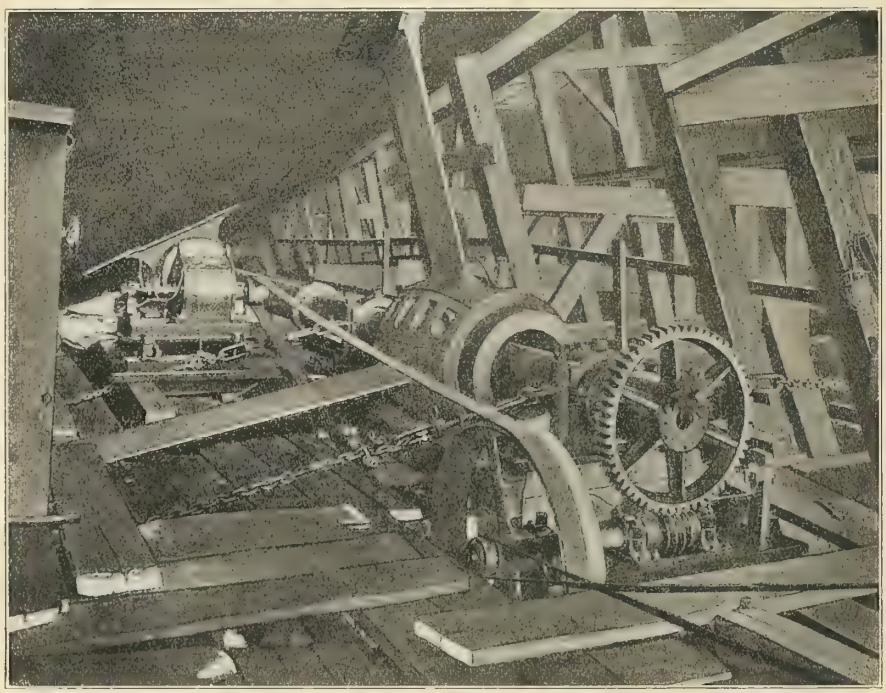
The beginning of the use of auxiliary machinery about the building slip was made by the Vulcan Works

*Translated and abstracted for MARINE ENGINEERING from the *Jahrbuch der Schiffbautechnischen Gesellschaft*, 1901.

at Stettin. The construction of a large number of cruisers (iron body with wood planking) induced the installation at these works, toward the end of the seventh decade of the century, of a line of shafting from the ship shed to the building slip, from which, by means of rope drives, portable boring machines were driven in order to drill the holes in the outer plating for the bolts of the wooden planking.

Close upon these drilling machines came the portable hydraulic riveting machines, which, with the method of building first developed on the Clyde, gave very good service for riveting the frames, floors, and beams in the frame shed. This as a whole was then erected in place at the shipway. In this manner the work was facilitated, because on the one hand the riveting on a level floor was easily carried out with hydraulic machinery, while on the other hand the transport of the material was simplified by the erection of the frame in one operation. There was also in England, at about the same time, a so-called shipway crane, a form of stationary derrick crane which, in the works of A. Stephens and Sons, was used to set into the ship heavy machinery and parts of boilers before the launch, but was not used for the construction of the ship itself.

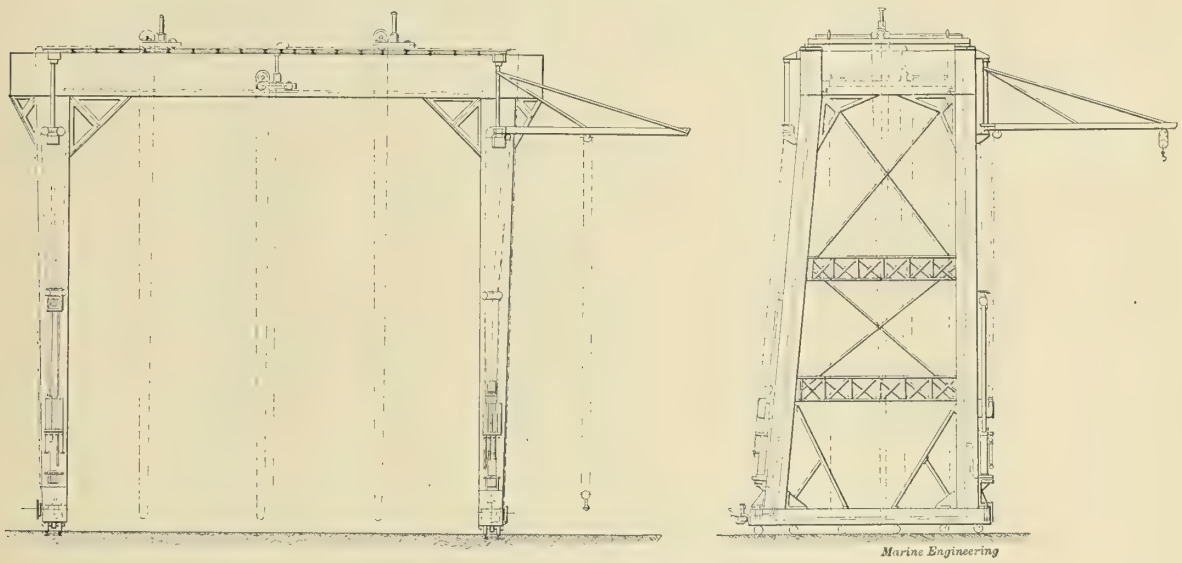
Then, later, the development of the electric transmission of power made possible a further step for the improvement of means of transport, as well as for widening the scope of machine work at the building slip. The installation from an electric central station of suitable wiring to carry the electric current to any desired place, and there by the help of portable motors to drive auxiliary tools, proved of so great value to the work at the building slip that in shipbuilding this electrical distribution of power soon took strong hold. It came about, furthermore, that the electric current was not only employed for the operation of hoisting machinery, and also for the driving of auxiliary tools, but also with the same distribution the very important requirement of lighting the ship throughout its inner compartments could be fulfilled. The extension of electric lighting throughout the entire shipyard, including building slips, increased also in notable degree the efficiency of operation of the yard, as in the winter months the shrinkage of the working time was, in large measure, prevented. Thus, where previously workmen on board must work by smoking oil lamps or candles, now arc lamps are provided, and the work, whether in day or night, can readily be carried forward. Furthermore, as the lower passages and compartments may be lighted by incandescent lamps, so the facility of working has become greater, and accidents are the less likely to occur. In order to give a general view of the extent to which electrical power for the work at the building slip may be employed, reference may be made to the more important features of the Imperial Dock Yard at Wilhelmshaven.



MOTOR-DRIVEN RIG FOR BORING SHAFT STRUT AT WILHELMSHAVEN.

The foundation of the electrical central station followed the laying of the keel of the battleship *Kaiser Friedrich III.*, and the plant was further increased upon the building of the battleship *Kaiser Wilhelm II.*, so that for the operations about the building slip altogether 17 motors were employed. Of these, two of 3 1-2 H. P. were employed solely for the transport of material, while the others were used for driving various machines. The transport of material about the slip is effected by two traveling cranes which run upon a "U" track. This track corresponds in slope to that of the slip, at a grade of 1:16. The motion of all the cranes results by means of a chain carried from a chain wheel on the crane. The reach of both the cranes measures 10 feet. The turning of the masts is by hand power,

while the hoisting machinery is driven by a 3.5 H. P. motor through worm and spur gearing. Motors are arranged to run in either direction and are provided with reversing switches and brakes. The peculiarity of the construction of the crane lies in the fact that it is arranged in two stages; that each crane first operates on the lower stage, which is at the height of the armor shelf of the battleship. As the construction is then carried further above, the crane then builds for itself its second stage, standing on struts and beams which are bound together above with the rails, and which reach from stem to stern. Through the construction of the crane in two stages, it follows that it is necessary to lift the material only so high as its place in the construction of the ship makes necessary. Each crane, which weighs in round numbers 5 tons, has a lifting capacity of 3 tons, with a speed of 13 feet per minute. The material is brought alongside the building slip by means of small cars, and is then taken direct by the crane and carried to its place



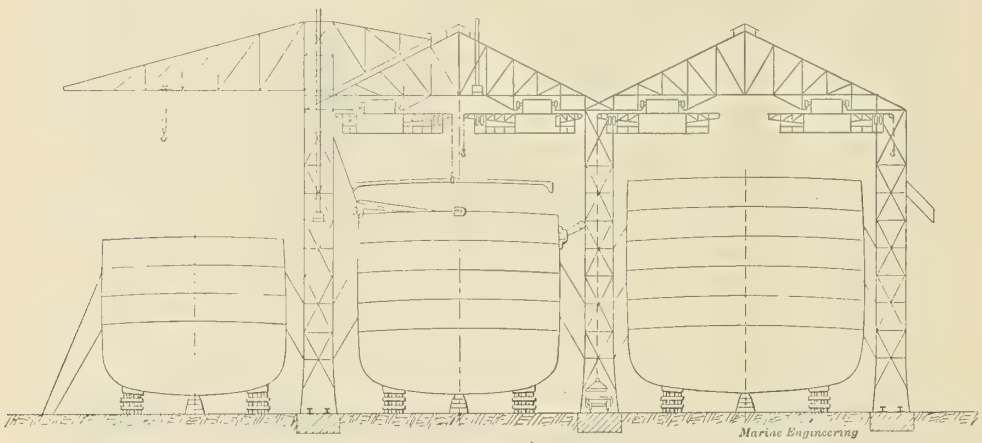
CRANE AT HARLAND AND WOLFF'S YARD.

in the ship. For the erection of beams both cranes can work together. Of the remaining motors, one of 9 H. P. capacity is used to drive the machine for boring the stern posts, shaft struts, and bearings. The comfortable and easy mounting, the quick and uniform operation of the motors, as well as the economical application of electric power, have resulted in quickly displacing the steam traveling crane formerly used for these purposes. Since for these operations of the motor its use is required for only two or three weeks, for the remaining time it is available for driving small reamers or drills which are used in connection with the fitting of transverse members of the structure. Six motors of 3 1-2 H. P. are used for driving the boring and tapping machines required in connection with the numberless holes in the armor deck. The 3 1-2 H. P. motor drives a short transmission shaft, from which, by rope drive, the driving shafts of three to four boring or tapping machines are operated. After the fitting of the armor deck, motors are used for driving manhole-cutting machines, or portable machines for the cutting and sawing of deck openings, or for the driving of portable cold saws for the cutting of beams, angles, etc. The small weight of the motor makes it easy of transport, so that it can be utilized for that part of the work where most needed. Certain motors, however, remain stationary during the entire time. Of such are a 25 H. P. motor for driving the air compressors for compressed-air tools, as well as two little motors for driving centrifugal blowers for giving blast to the rivet furnaces. The rivet boys are thus relieved from blowing the furnaces and can give their entire attention to the heating of the rivets. For the ventilation of the double bottom portable motors are also used, and it thus appears that electric transmission of power possesses great advantages even with reference to the health of the employees. In conclusion, mention may be made of the electric-driven centrifugal pumps which are used for filling the separate water-tight compartments with water from the harbor, and, after the same, for pumping them out. For the first operation the pump is erected on the quay wall; for the last, on board ship, so that the height of lifting the water is small. For merchant ships, furthermore, electric-driven deck-planing machines have been found of special use.

These examples may serve to illustrate the manifold applications of electric power for the work at the building slip. For many purposes, however, electricity has a powerful rival in the modern type of hydraulic or compressed-air tools, which likewise draw their power from a distant-placed central station. Especially is this true with regard to mechanical riveting, which may be well done with hydraulic power or by means of compressed air. Electric-driven riveting has only recently come into use. Further, the pneumatic hammer, which is also used for chipping and calking, stands at the present time without a rival, while the pneumatic boring machine strongly rivals those driven by means of electric power.

Hydraulic riveting machines, which in England first came into wide use for shipbuilding purposes, have in recent times become almost a necessity, especially with the recent great increase in size. The thickness of sep-

arate items of the structure must in consequence be so increased that, for example, keel plates and sheer strakes of the outer shell exceed 1 inch in thickness. With such material hand-riveting is inadequate, and the excellence of the work is wholly dependent on the strength and skill of the riveter. For this reason the firm of Harland and Wolff, in building the *Oceanic,* concluded to erect a powerful gantry crane, which was especially intended to provide for the transport of a suitable number of portable riveting machines in such manner that in all parts of the ship they might be used to good advantage. Such an arrangement is only possible in the mild climate of Ireland, where winter frost seldom gives trouble and freezing of water in the tools is not to be expected. The yard of Harland and Wolff has three large gantry cranes for the three building slips. The opening in the clear between the pillars measures 90 feet, and the height of the rails to the lower edge of the cross-beams 95 feet, so that they may pass over the largest ships. The cranes run on two rails 577 feet long, which correspond to the slope of the slip, 1:24 in the arc of a circle. Each gantry crane carries three hydraulic traveling cranes of 10 tons capacity, two on the upper and one on the under edge of the cross girders, to which the hydraulic riveting machines are hung by means of chains. At the four corners of the crane are, furthermore, four derrick masts, each one of four tons capacity, operated by hydraulic power for hoisting and swinging. The same are used for carrying electrical boring machines, as well as for the erection of frames and for handling shell plating.

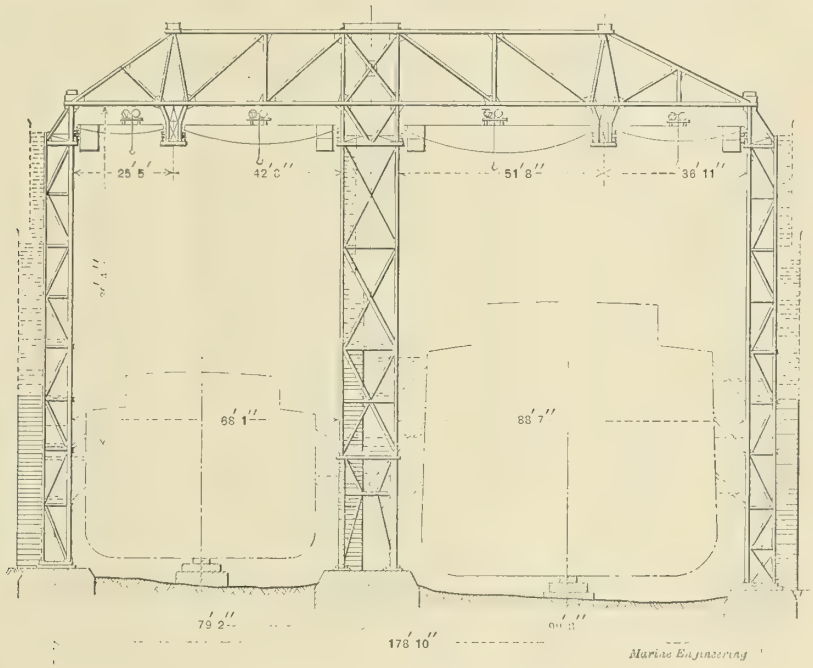


SHIPWAYS AT THE WORKS OF SWAN AND HUNTER.

Compressed-air appliances are especially of American development. They are at the present time largely used in America and in American yards, and are more especially applicable for the work at the building slips. In German yards compressed-air tools in recent years have found more and more use since the pneumatic hammer has been improved with reference to the jar on the operator. Also the pneumatic riveter, since it is similar in operation to the hand hammer, possesses alone the capacity for riveting mechanically the shell plating.

From the previous developments in these lines, and having in view the present condition as regards the use of electrical power and the application of hydraulic riveting machines as well as compressed-air tools, such as riveters, boring machines, chippers, and calkers, as well as all manner of auxiliary work at the building slip, it is clear that further developments along these lines are to be expected. The building slip is no longer a building and erecting place. It has rather, in the widest sense, become a workshop in which the whole ship's construction is erected, riveted, and completed. Since, furthermore, with reference to every workshop, it is clear that it should be brought under a weather-proof building, so that on the one hand the tools should not suffer and on the other the workmen should be protected against the weather, the simple conclusion follows that the building slip should be covered over and the construction closed in on two sides. The building slips of warship yards in the time of wooden shipbuilding may thus again be brought into use, although somewhat improved in their modern form. While the old wooden ship house was without top light, and was intended simply to protect the building material, the costly frames, and planking from dampness, the modern iron-and-glass-covered ship house is not intended so much to protect the building material as the costly machinery, and to provide for the workman a healthful, dry, and, in winter, a warm working place. I know that through this new construction the capitalist is heavily laden, and that the capital must be increased in order to provide for the cost of this new construction. I hope, however, to be able to show that a building slip workshop, when properly arranged, may be able to pay and to provide for the necessary interest and depreciation on the investment. For, with such a building provided, it is a simple matter to equip it, as with modern workshops, with suitable and efficient lifting devices, with traveling cranes, etc., which are essential for suitably carrying on the work. These lifting devices claim, moreover, special attention when it is remembered that the weight of the hull at launching, and thus up to the time at which the ship leaves the building slip, in the case of modern ocean liners as well as with the combined freight and passenger steamers, is 9,000 tons and more. It must be remembered that in a closed building slip lifting machines of every sort and in every location can find use, and that even hanging of heavy hydraulic machines, as with the gantry crane of Harland and Wolff, is possible; that, furthermore, the scaffolding for the

riveting of the shell is easily arranged by the use of the structure of the building, and that in many ways it becomes easily possible to make such a construction useful to the fullest extent. In winter it also results that with such a roof over the building the work is not deranged by snowfall, and walking over the scaffolding and parts under construction is accomplished without difficulty. The only drawback, the slight darkening of the building slip, should not be considered serious, since electric lighting is provided for all parts of the ship. It is, moreover, a fact of importance that there is difficulty in obtaining a sufficient number of apprentices for shipbuilding, while the engine shop is not troubled with any difficulty of this character. Young people prefer to work in a closed shop which provides shelter against rain and cold, and in which, furthermore, the work is restricted almost entirely to hand-



OVERHEAD CRANES AT THE VULCAN YARD.

work operations, since suitable means are provided for the handling of heavy materials.

The first covering over a building slip was installed by the firm of Swan and Hunter on the Tyne. The whole establishment is built according to the ideas of Mr. G. B. Hunter and is suitably protected by patents. The special features are seen in the section through the slip and in the plan of the crane on page 350. In this construction a roof is placed over two slips, which at the same time serves to carry tracks for a traveling crane serving a third uncovered slip. The roof has a length of 500 feet by a height in the clear of 80 feet. It is built in the main of channel section posts bound together with diagonal strut and tie pieces. This framework and general type of construction provides readily for the arrangement of struts for supporting the hull, for the operation of riveting machines, and for horizontal runways for the use of rivet boys. Above, the posts are bound together by the members of the roof construction, which have sufficient strength to carry five electrical traveling cranes of three tons capacity. The width of one slip in the clear is 78 feet, and of the other 82 feet. The posts of the roof at the bottom are so constructed that between their structural members there is room for a narrow-gauge railroad. Material for the ship can, in this manner, be taken by the crane either at the head of the slip or along either side of the ship and carried to the place where needed. This slip has two tracks for the cranes, which are extended over the whole length of the roof. The cranes are operated by an electric motor, and are provided for hoisting, traveling, and turning of the cranes through gearing as well as through belt driving. Near the tracks for the cranes are placed, also, a number of rails for carrying riveting machines. The roof is for the most part covered with glass, as well as the upper portion of the side walls. Below, the walls to a height of 33 feet are open, and in winter are covered temporarily by canvas or wooden panels. In such a slip, in 1899, the *Ivernia,* at that time the largest combined freight and passenger steamer which had been built on the Tyne, was in nine months constructed up to the condition for launching, and, according to the statements of the owners, it was possible to build into the structure in that short time a weight of 8,000 tons. A similar appliance is found at the Union Iron Works in San Francisco, and here for four slips. The first construction was built in 1884, the others later, and all of wood. The latest is 408 feet long, 85 feet in width, and 78 feet in height, and the roof ridge has the same slope as the slip. At the head end of the construction are found three cranes 50 feet in length, while at the water end is found one of the same length, so that over a total length of 500 feet appliances for hoisting and transport are at hand. Under the roof two traveling cranes are arranged which, since the ridge of the roof is 3 feet out of the middle line, possess different spans, so that the outer end of the longer crane

extends beyond the middle line of the ship. Since the track of the cranes is on a slope, it is necessary to provide special means for their locomotion. This is brought about through the winding and unwinding of ropes on two drums at the ends of the cranes. These cranes have a traveling speed of 200 feet per minute; the travel has a speed of 100 feet per minute, and the hoisting speed is the same. The capacity of the crane is 5 tons. The wooden pillars of the roof are provided with holes, so that at any convenient height means may be found for the support of the ship staging.

Note may be made of the manner in which riveting machines, whether hydraulic or pneumatic, are supported. To this end nine pillar cranes are mounted on the standards supporting the roof. From each two of these cranes is hung, by rods, a beam to which the riveting machines are hung by means of a traveling carriage. In this manner the riveting machines may be placed wherever required and at any level in the ship. Through this arrangement it is furthermore possible, even during the operation of the rivet machines, to use the traveling cranes for carrying or hoisting material. As the wooden pillars are spaced twelve feet apart, the approach of material from the side is not practicable, and all large members must, therefore, enter at the head of the slip. The three pillar cranes at the head of the dock are also available for handling riveters for working on frames.

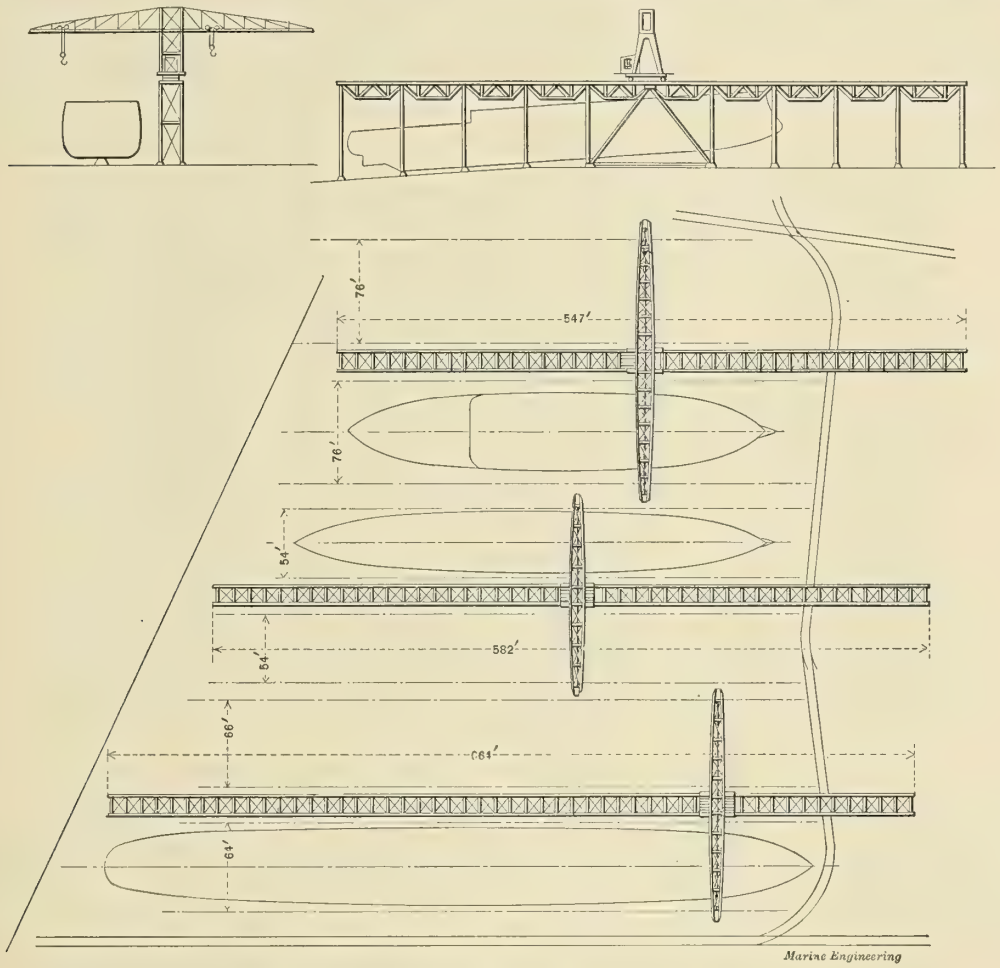
In Germany slipway cranes are not yet in use. The Krupp Germania Works, in Kiel, have designed for their new dockyard a roof and traveling crane. The Vulcan Works are about to provide slipway cranes for their four large building slips for mercantile construction. The entire equipment for each building slip stands on a kind of shed-like structure, which carries, by means of four strong traveling ways, two traveling cranes of four tons capacity. The traveling cranes have different spans, 62 feet, 43 feet, and 31 feet, similar to those of the Union Iron Works, in order that one of the cranes may be able to cover the middle line of the ship, and the cranes are built on the three-motor system and take current at 500 volts. The speed of lifting is 33 feet per minute, for the travel of the trolley 66 feet, and for the travel of the crane itself 260 feet per minute. The control station for each crane is at the side, so that the trolley can travel to the extreme run on either end. The arrangement of the cranes is in such manner that all objects received at the upper end of the slip may be taken by the crane and transported to the place where required. The height of the crane structure is also very large, in order to give sufficient room between the upper deck of the ship and the crane. The building is also provided with horizontal platforms, which are reached by suitable steps. These are constructed with sufficient strength so that the ship may be braced against them. Between the upper timbers on this platform are further fastened vertical posts which provide for staging for the riveters, while between these wooden struts may be inserted and made fast.

Besides these cranes, as above described, special handling cranes are in use in many of the large American yards, such as those installed in the William Cramp and Sons' Ship and Engine Building Company, Philadelphia, and in the Newport News Shipbuilding and Dry Dock Company, Newport News, Va. These are cranes of the cantilever type, made by the Brown Hoisting and Conveying Company. The cranes run each upon tracks carried upon a lofty framework structure, which is located between two slips in order that the crane with its traveler may serve both sides. While the traveler is run out to one side, at the same time on the other side a counterweight keeps equal pace, thus equalizing the forces. The crane can, therefore, pick up a load on one side at a time only. For the operation of the crane a 50 to 80-H. P. motor serves, located in a house under the traveling girder, and from which the power for moving girder, traveler, and for lifting the weight is derived through friction coupling. The speeds of operation of the crane are especially high. Thus the speed of hoisting the weight is 250 feet per minute, the travel of the main crane 650 per minute, and that of the cross trolley can be made still faster. This shipyard possesses three such cranes, with corresponding tracks, as follows: One crane for two battleships, each of them of width up to 76 feet, capable of hoisting 4 1-2 tons at a distance of 95 feet, or 12 1-2 tons at a distance of 60 feet, to a height of 92 feet from the ground; second, one crane for two merchant ships up to 66 feet in width, with a capacity of 3 tons at 78 feet, and 10 tons at 46 feet, at a height of 95 feet; third, one crane for two cruisers up to 54 feet width, with capacity of 12 1-2 tons at 39 1-2 feet to a height of 85 feet. The Brown hoisting crane can be used for handling various heavy weights, and serves not alone for the transport of the lighter parts of the ship, such as plates and angles, but also for the heavier forgings, stem, stern posts, etc.

Regarding the advantages of such cranes, weights of 12 1-2 tons and downward to single angles and plates of a few hundred pounds weight with correspondingly higher speed may be hoisted and carried. The chief disadvantage lies in the fact that, as a rule, only half the crane can be in use at one time, since it is intended to serve two building slips. Even if the hoisting as well as carrying the piece to its place in the ship can be carried out in one minute, the crane must remain at this location often some eight or ten minutes for adjusting and fastening the piece, so that it is not always possible to handle promptly all material for the two ships under construction at the same time. With an average weight of 1,000 pounds, with 10 minutes for securing in place, the maximum capacity of one crane will be 30 tons per day for the two ships.

A more rapid rate of work would be difficult to bring about, and the considerable distance between the operator of the crane and the workmen on the ship makes it difficult to maintain a quick understanding between the two. In addition, it should be remembered that the elevated structure cannot be used for supporting the scaffolding about the ship, and the provision of a roof over the crane is also not feasible. In comparison, the style of traveling crane previously referred to presents important advantages. Thus, for each ship, as we have seen in the illustrations given, two cranes are ready for use at the same time with capacity from 3 to 5 tons, thus providing for all parts of the structure excepting the stem and stern posts. For such purposes the two cranes may be operated together. As the crane operator is located directly over the workmen at the ship,

a ready understanding with the latter is possible. The necessary structure for such a crane can furthermore be used for supporting the shores of the ship and the surrounding scaffolding, for the support of riveting machines, etc. This structure can furthermore, without serious cost, be covered with a roof in order to protect the machine and workmen. It is clear, furthermore, that for the climate of Germany such constructions with protecting roof have special advantages. When, therefore, the Germania-Werft, in Kiel, undertook the construction of a building-slip crane of this character, and, in addition, provided a massive structure with dock



BUILDING WAYS AND GANTRY CRANES AT CRAMP'S SHIPYARD.

gates, in order on the one hand to keep the height of the ship lower for launching, and on the other to be able to provide for the launching with greater care and security, the natural development would seem to point toward the abandonment of the inclined plane and the construction of a shallow, level dry-dock. Such a dry-dock, with a depth of the sill some 15 or 20 feet below the normal level of the water, provided with complete roofing, should without doubt provide the building place of the future for war and mercantile marine. The chief advantage which such a dock brings is in regard to the launching. For the laity—that is to say, for those not accustomed to the work in a shipyard and who delight in the spectacle of a launch—such an advantage would have small value. The shipbuilder, however, who, through his familiarity with such work, must take upon himself the care and responsibility of such an operation, would gladly be relieved from the anxiety which such occasions force upon him. Even if the provisions for a launch according to the laws of mechanics is a simple problem, and even when all computations and every provision have been accurately made, still it seems unnatural that the builder of the ship should give it over entirely out of his hands and into the control of the elementary forces of nature. And, in fact, in the history of shipbuilding, we find a sufficient number of examples which teach that misfortune in launching is not unusual. If the ship sticks on the ways and does not start at the prescribed instant it is not necessarily so serious a matter. The expectations of the invited guests are simply disturbed, and their patience in the meantime is simply called upon to undergo a moderate test. If, however, the ship first starts off freely and then comes to rest, or should the ship capsize on entering the water, then loss of life and injury to the material of the ship's hull may follow, which at one stroke will sweep away the profits of the unfortunate builder. This uncertainty in launching has induced private builders to insure large ships against accident in launching, and the premium, which has reached $3,750, shows clearly

that the result of the launch is not so sure as one in general may be inclined to believe. The difficulty of a launch increases, however, in marked degree with the increase of launching weight and with the length of the ship, and especially for those yards where it is necessary to launch into a river of limited width. Thus, for example, the English firm, Laird Bros., for some years have used their stone docks for the building of warships and mercantile steamers, and at the royal dock yards in Portsmouth and Chatham the dry-docks have been used for building ships of the line, while in Germany the firm Seebeck, in Bremerhaven, used similarly a wooden dry-dock for the construction of the steamship *Trier*. These examples relating to the construction of ships in dry-docks should serve as an indication that the advantage of such mode of construction, as compared with the use of the ordinary building slip, can scarcely be denied. How much more important become these advantages for the building dock when it is constructed especially for this purpose, in which case the special depth of the ordinary dry-dock is not required, and only sufficient depth is given to allow the ship in launching condition to freely float over the dock sill. In such case the space required for the dock is very much decreased, and the work of preparing foundations is very much simplified. If, then, such a building dock is covered with a protecting structure, and provided with suitable handling mechanism, provision would be made for an arrangement of work which should fulfil the highest demands of future construction. It may be urged against such a type of construction that it is too expensive, that such a manner of carrying on the work would require such an increase in working capital as to give rise to serious difficulty to insure a suitable return on the investment in periods of business depression. It would carry us beyond the limits of the present purpose to discuss in detail the cost of such an installation, and it must suffice to mention briefly the chief points in favor of the building dock.

(1) Elimination of the launch and the uncertain and serious expenses connected therewith.

(2) Elimination of much of the work of arranging the building slip.

(3) The width of river or channel is a matter of no importance, and there will be no expense required for dredging and widening the existing channel.

(4) The insurance premium is no longer necessary.

(5) Work on the ship can be carried on until the last instant.

(6) All transverse members of the ship are built in an upright position.

(7) The support of the ship is at the same level, and, in consequence, under the fore body, much lower than with the building slip.

(8) As the keel of the ship is located somewhere about 15 feet below the water line, and therefore some 16 or 17 feet lower than the level of the building slip, it follows that the building material has, on the whole, to be lifted but slightly.

(9) The scaffolding is simpler and lower.

(10) The time of the launch or exit from the dock is independent of the conditions of the water, as the ship can be hauled out of the dock at any time.

(11) With reference to the covering over the dock, it may be noted that the height of such structure is very much less than with the building slip, and that for its foundation the walls of the dock may be employed.

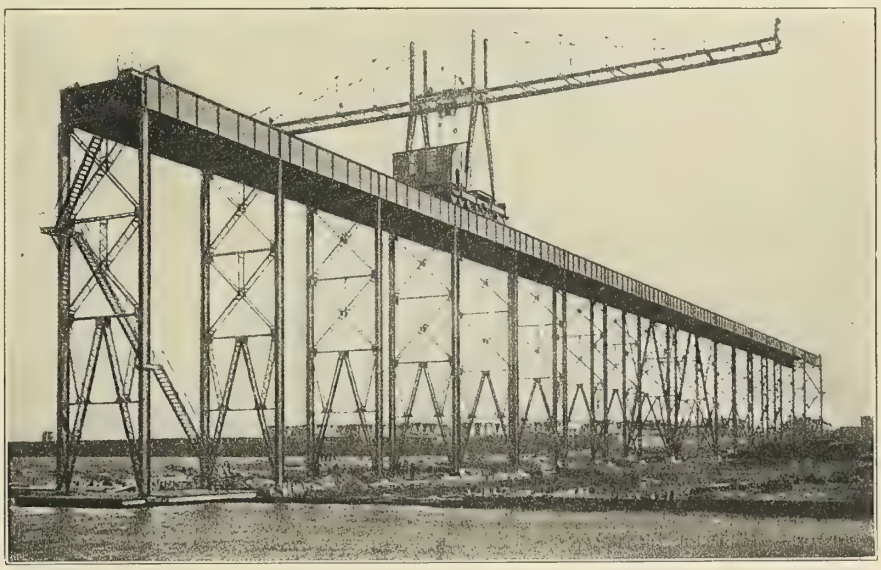
The disadvantages, the ventilation and drying of the dock, and the increase of electric lighting, with the modern extension in the system of electrical distribution are not of so great importance. With reference to the financial aspect of this question, if one considers a ship like the *Ivernia* (13,000 gross register tons), or, on the other hand, a ship of the line or a large cruiser of ten to twelve thousand tons displacement, and if one considers that ships of this size in the course of nine months can be completed sufficiently to float, it follows that for this time and for such ships there would be a saving of at least $30,000, or, for twelve months, say $40,000. If the expense of maintaining the dock is estimated at $6,000, there results a gain of $34,000 a year. If the construction of a building dock per square foot is reckoned at about $10, the cost of a dock 650 feet long and 85 feet broad would be about $550,000. If the decreased cost in roofing and covering, as compared with a building slip, is estimated at $50,000, there remains the sum of $500,000 to be charged against the construction of the dock. The saving above noted would pay the interest on such a sum, even at 6½ per cent. Further consideration should be given, however, to the fact that since the construction of the ship in the dock may be carried forward much more rapidly than in a building slip, the productiveness of the invested capital as a whole is thereby much increased.

After the floating or launching of the ship the second period of construction begins. It is of the greatest importance during this second period that means for transportation should be ample and so arranged as to work with the highest possible speed, in order to provide for the great variety of articles, as well as tools, which must be transported back and forth. In most dock-yards this relation between the workshops and the ship has not received adequate attention. Very often the machine shop, as well as the boiler shop or pipe-fitting shop, are far removed from the building slip, and often separated by a street, or in some cases such shops are located at a different place entirely and are only connected with the shipyard by a railroad. As a rule, furthermore, the weights of the boilers and parts of the engine are so great that the usual means of transportation are not sufficient. It becomes therefore desirable, so far as possible, to locate such shops conveniently to each other, and then for their suitable connection to provide some form of traveling crane. This close connection has the further advantage that the various shops and tools can be better united under one management, so that different tools may be better utilized and the efficiency of the administration increased. Why, for example, should the shipbuilding section be provided with a forge shop and the engineering section with boiler and forge shops independently? Why should these three shops not be united in one? In all three are to be found, in similar fashion, smiths' fires, heating furnaces, steam or air hammers, and in the boiler shop in particular the operations on the plates are similar to those on the heaviest of the plates required for the ship. In such case use can be made in both general departments of the work of rolls, plate planers, boring

mills, and hydraulic riveting machines, and for all these implements a central power station can be provided. Why must, further, the fitting shop for the ship be separated from the general or engineering machine shop? Most of the tools in the two shops are entirely similar. Through a centralization of all these tools in one shop a notable increase in efficiency may be obtained, and the details may be advantageously administered with reference to the work as a whole. The same is true in connection with the coppersmith's shop and paint shop. As to whether any advantage would arise from a combination of the carpenter shop with the patternmaker's shop, there may be still a difference of opinion, since the carpenter shop should be located conveniently to the water front, while the pattern shop is better located in the neighborhood of the foundry. The chief thing remains that the separate shops should be arranged, so far as possible, conveniently to the dock on the water front, and that suitable arrangements should be provided between the shops and the ship. We are thus naturally brought to the consideration of recent improvements which the advances in hoisting machinery have provided in the form of special types of dock cranes.

The method previously employed for transporting heavy weights, such as boilers, from the boiler shop to the dock, usually involved the use of some form of trackway connecting the two places, upon which traveled a suitable car. By means of a crane in the shop the boiler was loaded on the car, and was thus transported to the dock front under the dock crane or shears. The use of such tracks in a shop has many disadvantages. With the modern electric-driven traveling crane, which reaches a speed of 300 feet per minute, it is now a simple matter to pick up an article in any part of the workshop and carry it to the shop exit. If the latter is provided with an opening for the crane, and the track is lengthened outwardly above a track on the ground, it becomes an easy matter to deliver the weight direct to a car standing upon the tracks outside, without any necessity for the latter entering the shop itself. Such cranes are provided at the Donnersmarkhütte, in Oberschlesien, in their boiler shop. The slide for covering the opening necessary to allow the crane to pass in and out is operated by hoists from below. If, in this manner, a collection of shops is connected together, the transport of materials to the dock crane, or from one shop to another, may be carried out in the simplest possible manner. Naturally, with the present development in electric traction, electric locomotives will find a use in effecting transport of material in this manner.

(To be continued.)



GANTRY CRANE AT NEWPORT NEWS YARD.

Pacific Terminal.—The great Northern Railway Company has decided to make Seattle, Oreg., the eastern terminal of the line of Asiatic steamships.

A Pension at Shipyard.—The Vulcan Shipbuilding yards at Stettin, Germany, have inaugurated a pension fund whereby employees, on the payment of an initiation fee and annual premiums, receive a pension upon their retirement from the works. In case of death the pension is paid to the widow or children. The shipyard pays a premium equivalent to that paid by the members.

Inspector of Hulls.—The United States Civil Service Commission announces that on July 8 and 9 examinations will be held in various cities throughout the United States for the position of Inspector of Hulls in the Steamboat Inspection Service at Evanston, Ind., at a salary of $1,200 per annum, and other similar vacancies as they may occur. For further particulars address the Commission at Washington, D. C.

Oil Fuel.—The ships of the American-Hawaiian Steamship Company are to be converted into oil burners. The steamship *Nebraskan* of this company, recently launched from the New York Shipbuilding yards, and now on her way from New York to San Francisco, has already been equipped with oil-burning apparatus and upon her arrival at San Francisco will discard coal. The vessel will take fuel oil at New York and San Francisco, and also replenish the supply from a tank ship stationed in the Straits of Magellan.

Wreck of the Acara.

The accompanying illustration, as reproduced by permission of the *Brooklyn Eagle,* shows the British steamer *Acara,* which went ashore between Fire Island and Coney Island on March 1. The place where the ship grounded is unprotected by lighthouses, and at low tide there is but 18 feet of water as far as a mile and a half from the shore. Many vessels have been wrecked along this coast.

The *Acara* was bound from Shanghai to New York with a cargo of tin, silk, tea, and spices. The vessel struck head on, and the force of the waves soon drove her to the north end of the beach, and as the entire crew of sixty were composed of Malays, Hindus, and Chinese, the greatest excitement prevailed, which for some time the officers were unable to quell.

The wreckers were soon at the scene and unloading the cargo, most of which, however, was a total loss owing to damage by sea water. The ship could not withstand the strain of the tremendous seas that broke against her sides and dashed over her decks. The ship gradually sank in the sand and split in two, as shown in the photograph. An attempt was made to take the vessel off in halves, as she is comparatively new. The attempts, however, to salve the ship were unsuccessful, and the wreck has been abandoned.

THE STEAMER ACARA SPLIT IN TWO OFF THE LONG ISLAND SHORE.

The *Acara* was built at Newcastle four years ago, and was 380 feet long, 47 feet 4 inches beam, 29 feet deep, with a gross tonnage of 4,193 tons.

Webb's Academy.—The eighth annual report of Webb's Academy and Home for Shipbuilders, Fordham Heights, Bronx borough, New York city, shows the condition of this institution to be flourishing and the work carried on by the students to be of increasing importance. The members of the marine engineering section, besides their usual studies, have designed marine engines and boilers; and those in the section of naval architecture have worked out designs for fast vessels. Many visits have been made to neighboring shipyards for the purpose of study. The members graduated from this institution have secured good positions in various shipyards.

The Selection of Lubricating Oil.

Oil intended to lubricate bearings, slides and other rubbing surfaces should be invariably pure mineral oil, devoid of any vegetable or animal fat. Vegetable oils have no lubricating properties whatever, and oxidize at a comparatively low temperature, becoming thick and gummy; animal oils also thicken and become sticky and gummy when exposed to the influence of the atmosphere and the warmth of rubbing surfaces. Animal and vegetable oils are often compounded with a mineral oil in order to produce an engine oil having high viscosity and fire test; such a compound should never be accepted at any price. In order to test engine oil for "loading," put a little caustic soda or soda ash solution in the oil and shake it up. If it clouds up and looks soapy this is an indication of animal oil.

Paraffine is also highly objectionable. A convenient test for paraffine is to put a bottle of the engine oil on ice for fifteen or twenty minutes; if the oil becomes cloudy, it is loaded with paraffine and should be rejected without further argument or investigation. Engine oils having an opalescent green tinge when held up to the sunlight, instead of appearing clear yellow or red, are adulterated with either kerosene or some lighter hydrocarbon, which is not a lubricant and which volatilizes as soon as it is warmed by the friction of the bearings. Any engine oil, therefore, which has the slightest tinge of opalescent green should be rejected. Engine oils for high speed should show a viscosity of at least 170 and should range from that point up to 195 at an ordinary temperature, say 75°. The oil should have a specific gravity of about 30; it should not be under 29 nor over 31. The flash test should be between 400° and 440° Fahr.

Cylinder oils for use in connection with a cylinder where the steam pressure is less than 100 lbs. per square inch should show a fire test not less than 590° nor more than 630°. For pressure over 100 lbs. and up to 200 the viscosity should be from 640° to 660°. The specific gravity of a cylinder oil showing a fire test of 600° should be from 26 to 27, and for a fire test

of 660° the specific gravity should be about 24 to 25. Unless there is considerable moisture in the cylinders, cylinder oil should not contain any animal oil, and vegetable oil should not be used under any consideration. If animal oil should be necessary, acidless and refined tallow oil should invariably be used. For steam pressures of 100 lbs. or less, 8 to 10 per cent. of tallow oil may be compounded with mineral cylinder oil; and for pressures of 100 to 200 lbs., 3 to 6 per cent. may be used. Common lump tallow should never be used for compounding, as it contains acid which attacks the metal of the cylinder walls and leaves charred particles in the steam.

An adulteration commonly found in cheap grades of cylinder oil is wool fat, which is used to cut the gummy ingredient and give the oil a good flow in a cold test. Wool fat causes separation and a thick deposit in the bottom of the barrels, and results in the same charred deposit in the cylinder as lump tallow.—*American Electrician.*

Auxiliaries of the Korea.—In describing the auxiliary machinery of the *Korea* and *Siberia* in MARINE ENGINEERING of May, the third circulating pump should not be used in connection with the first of the list of pumps on page 212, as the main air pumps are separate from the circulating pumps. There are, however, two auxiliary horizontal, simplex air and circulating pumps, each having a 10-inch steam cylinder, 12-inch cylinder, 12-inch water cylinder, and 12-inch stroke.

Replacing the Bottom Plating of a Steamer.

The British steamer *Wilster,* which grounded on the beach off Rockport, Mass., some weeks ago, and was illustrated in MARINE ENGINEERING for April, has since undergone repairs at the John N. Robbins Company, Erie Basin, Brooklyn, N. Y., of a very extensive nature. The accompanying illustration of the bow plates shows the character of the damage sustained to her entire bottom.

As stated, the vessel stranded on the beach and remained there for several days during more or less stormy weather. The weight of the ship resting on the soft sand bent the plating between the frames so that the bottom was corrugated from bilge to bilge for almost the entire length. At the bow the shoe plate was badly jammed and twisted, and the stern frame was lost from the shoe to the 11-foot draft mark, carrying away the rudder with it.

DAMAGED BOTTOM OF THE STEAMER WILSTER.

All the bottom plating had to be taken off, some plates were rerolled, but most of them had to be replaced. The toes of the angle frames were heated and bent back without the frames being removed. The vessel was towed from East Boston, where she was first docked, to this port. The contract was $39,500, and the time allowance 35 days.

Monthly Shipbuilding Returns.—The Bureau of Navigation reports 126 vessels of 34,139 gross tons were built in the United States and officially numbered during the month of May, 1902.

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ACCORDING to recent reports, the experiments regarding the use of oil fuel for naval purposes, which are being carried on in Washington under the direction of Rear Admiral Melville, are meeting with gratifying success. For many years experiments along these lines have been carried on in a somewhat desultory way. It has long ago been shown, of course, that oil fuel under boilers could be burned and burned with reasonable efficiency. This has been shown beyond question with stationary boilers and with a considerable number of cases in the mercantile marine using fuel of this character. The chief difficulty which has been experienced with its use for naval purposes has been in connection with forced conditions. It has always been possible with oil fuel to obtain a high rate of evaporation per pound of fuel. The ratio of evaporation as compared with coal has often been stated at about 7 to 4 as representing the results under good average conditions. As compared with coal, therefore, there is a great increase in evaporative efficiency per pound of fuel. It has not been found practical, however, to force the combustion of oil to the same extent as that of coal, and in consequence the steam produced per square foot of heating surface or per pound of boiler under forced conditions with oil as fuel has not compared favorably with the results realized from coal. For naval purposes it is, of course, imperative that the boilers be capable of furnishing the utmost per unit of surface or weight, as these are the conditions existing in time of battle. For cruising conditions it is also necessary that due weight be given to the demand for economy per unit of combustible. It has been the difficulty of combining these two kinds of economy which has thus far worked against the wider use of oil for naval purposes. According to the preliminary reports regarding the present experiments, however, there seems to be a reasonable hope for improvement along these lines and for the development of greater capacity with oil fuel per unit of surface or weight. According to the preliminary statements, tests have been made under air pressures of 1 inch and 2 inches with a boiler of the water-tube type which had been previously subjected to exhaustive tests with coal as fuel. The results in both cases gave a greater output of steam with the oil than with the coal. In these tests questions of economy per pound of fuel were given no weight. The question of vital importance was simply whether with oil fuel or coal fuel the greater amount of steam could be obtained from the same boiler.

The experiments will be continued with burners of all types, and tests will be made having in view both efficiency per unit of fuel and per unit of surface or weight of boiler. From the data thus developed we may hope that a long step forward may be made in the practical development of means for utilizing our natural resources of oil as fuel both for naval and mercantile purposes.

From the strategic point of view, the importance to the United States of the development of means for the utilization of oil for naval purposes is of the highest importance. The United States has perhaps more to gain from the use of this type of fuel for warship purposes than any other nation. Our largest oil fields are within easy reach of the coast, and those of Ohio and Pennsylvania are already connected by pipe lines to several Atlantic seaports. The recent discovery of the Texas fields has given fresh impetus toward the wider use of oil as fuel, and among marine engineers there seems to be a general feeling that the possibilities of this type of fuel deserve the most serious consideration and study on their part.

THE growth in importance of the Navy, its maintenance and further development, is indicated by the grand total of the present Naval Appropriation Bill, which amounts to nearly $80,000,000. It is not so many years since the grand total covered by the Naval Appropriation Bill amounted to somewhere about $20,000,000. Naturally the larger part of the present appropriation is for the continuation of work on ships under present construction, together with such other sums as are needed for general maintenance of the service. The new ships proposed in the bill are six in number—two battleships of the heaviest and most powerful type, two armored cruisers, the most powerful of their type, and two gunboats.

A feature of the bill as presented by the House provided for the construction of one each of the above ships in Government navy yards. This provision met with the strong disapproval of the Government officials, and is omitted from the bill reported from the Senate. The proposition seems to be in entire disagreement with the policy of the Government for the past ten years, during which the equipment of the navy yards has been directed toward facilities for repair and maintenance rather than for original construction. It is true that in large measure the equipment required for the one is the same as for the other, but it is very sure that in the navy yards at present the equipment provided is far from being adequate for both. According to the opinion of the Chief Constructor over $500,000 would be necessary to equip the Portsmouth, New York, and Norfolk navy yards for battleship construction, while much larger expenditures would be necessary at Boston, where the present equipment is very small. The provision in the bill as reported from the Senate, that these ships shall not be constructed in navy yards unless it is found impossible to obtain satisfactory bids from private builders, will undoubtedly insure their construction in private yards.

Another feature of the bill, of far greater interest than the figures appropriated might suggest, is the item of $400,000 for an engineering laboratory building at the Naval Academy. We have already in these columns referred to the importance of the work which it is proposed to carry on in this laboratory, and the appropriation thus made will provide for the inauguration of the post-graduate engineering course at the Naval Academy, with its wide capacity for usefulness to the highest interests of the service at large.

ONE of the most notable features of the present trade situation from the engineering standpoint is the continuance of difficulty in obtaining structural material, especially for shipbuilding purposes. The companies represented in the Steel Trust will practically not consider an order for anything approaching early delivery. Their entire prospective output for the coming year is probably almost entirely spoken for. In special cases arrangements may be made for deliveries on certain things at periods approximating six months, but for anything in the nature of special stock, particularly in shapes and angles, it is likely that the consumer would be unable to make much better terms than delivery in one year. This has resulted, of course, in throwing an unusual amount of work into the small establishments not covered by the trust; and while earlier deliveries may in this way be obtained, in most cases such establishments are finding it difficult to keep up with the orders which are coming their way. It is hard to foresee how long such a condition can last. The present demand for such material seems to be enormously beyond the rate of production, but the very fact that producers are not inclined toward any large extension in their producing capacity is perhaps one of the best evidences that they consider the situation abnormal and temporary. It seems to be the purpose of the steel maker to carry the present business of the country without expansion of capacity, and in the meantime to keep his various customers as well satisfied as possible with such deliveries as he is able to make, lest added capacity in answer to present demand may soon become a useless investment. The practical result is simply that work must either be postponed until the material can be obtained, or it must be picked up in irregular and accidental ways, and, in the latter case, usually at an advance of from ten to twenty-five cents per 100 pounds. It is not too much to say that questions relating to the delivery of shipbuilding material are today giving the builders more trouble than almost any other question in connection with the present industrial condition. A readjustment between supply and demand is certainly required, and the present condition, from the very nature of the case, cannot be long-lived. The builder will certainly hail with delight the day when he can place an order on relatively short delivery, and with certainty that he will receive the material at the time specified and be able to finish the ship on time.

MISHAPS AND REPAIRS.

Stern Frame Broken by Sea.

The tug *Tatoosh,* while crossing out over the Columbia River bar on February 28, 1902, met with an accident which is best illustrated by the enclosed picture, taken while on Moran's dry-dock at Seattle, Wash. The cause of the accident is still in debate, the usual Board of Water Front Directors (found in every seaport) saying off-hand that she struck the bottom, though no one aboard the tug felt her touch, and I cannot conceive how she could strike hard enough to break a steel forging 4 inches by 10 1-2 inches and no one feel it aboard. I believe the damage was caused by a sea breaking under the counter in the following manner:

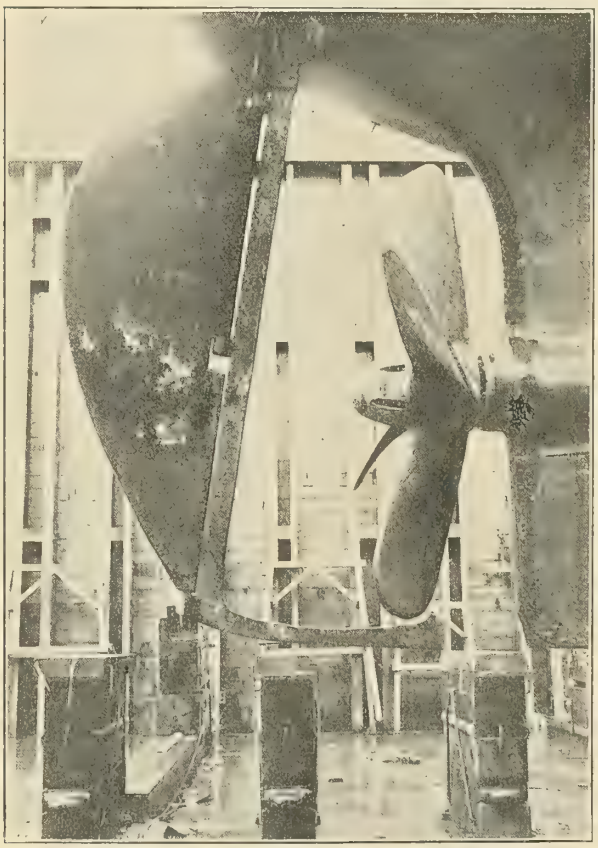


FIG. 1.—STERN FRAME BROKEN AT BOTTOM.

We were crossing out on a slow bell over a bar which had been impassable for three days previously, owing to a storm. The sea was at the time moderating, the tide running ebb, and wind and sea on the starboard bow. We proceeded nicely till on the outer edge of the bar, when, just as we were on the crest of a big swell, the wave broke, striking us with considerable force well aft on the starboard quarter, but none came aboard. At the time no attention was paid to it by any one of the crew, and we crossed out in safety. When outside in smooth water it was found that the boat would not answer a starboard helm, and investigation (above the deck) showed that the rudder stock was forced up through the deck about one inch from its normal position, and the tiller would only travel from amidships to one-half to port. Proceeding out into clear water, we stopped and could see a break and bend in the rudder just below the water line, the rudder post and shoe being visible and apparently all right. It was deemed unsafe to cross in again under these conditions, and the tug *Wallula* gave us a line in through the breakers, when we proceeded to Astoria under our own steam.

Tipping the *Tatoosh* with trimming tanks revealed the conditions shown in Fig. 2, and an examination by a diver informed us that the shoe had broken close to the stern post. We left Astoria March 11, the tug *Pioneer* giving us her hawser and preceding us up the coast until inside Cape Flattery; from there to Seattle we were unattended, and arrived safely on March 12, twenty-nine hours from Astoria.

The photograph, Fig. 1, shows the condition revealed when on the dry-dock, the break at the top showing less prominently than that below. The conclusion was that the damage was done by a breaking sea striking the rudder with the helm to port, the blow being greater than a steel beam, 4 inches by 10 1-2 inches and loaded

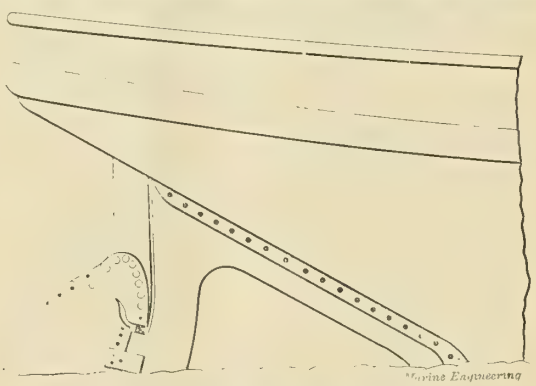


FIG. 2.—BEND IN STERN FRAME AT TOP.

at one end, could stand. The rudder was removed, taken to the shop, and the cover plates and rods and filling taken off. It was then found that the frame was cracked near the top in two places, as shown in the sketch, each crack extending nearly through the forging. Double patches were placed over the cracks and riveted on with through rivets, and in place of the original 1-4-inch plating 5-8-inch plates were fitted on.

Repairs to the stern frame were made, as in Fig. 3, by first heating the frame in the neighborhood of the crack by means of Well's lights in which coal oil was used for fuel, and also by heating the rudder post at the bottom fracture. The ends of the break were then drawn together with a chain tackle and the rudder post straightened. Rivets were drilled within the keel for a distance of 3 feet forward of the break and a shoe drilled for rivets 3 feet aft of the break. Templates were then taken and double-angle patches made of 1 1-4 inch mild steel, fitting over the plating and on the bottom of the bar keel, as shown in Fig. 4. After the patches had been fitted they were removed and puttied with a cement composed of litharge and glycerin, and then drawn up solid with through bolts and left until the cement hardened; then the bolts were removed, one at a time, and through rivets put in their places. The crack near the bottom of the rudder post was reinforced by a U-shaped patch put on in a similar manner.

Permanent repairs will be made in the fall and will consist of a new cast steel stern frame and a solid plate rudder, both of which will have to come from the East, as we cannot get steel castings on the Pacific coast.

These repairs were made by Moran Bros. Company at Seattle. In writing this article I intend to convey an idea of the force of the breaking sea.

F. H. NEWHALL.

Repairing a Copper Feed Pipe.

Editor of MARINE ENGINEERING:

DEAR SIR:—I have been very much interested in the accounts of accidents which have been published in your columns, and I thought that perhaps you might like to hear of a little experience which I had in my younger days. My first job in charge was on the *B*———, a small coasting steamer trading between Galveston and West Indian ports. The machinery consisted of a compound condensing engine of about 400 horse power with two single-furnace boilers. The machinery had been running about ten years with very little overhauling or repairs, so that in many ways it was in pretty bad shape. I was young and without much experience, but did the best I could, and we managed to get along pretty well in some sort of a way.

On the trip to which I refer we were bound for Campêche, and the first accident occurred as we were running across the Gulf the first night out. Signals of distress were sighted on deck, and, running down to them, we found an English steamer, about our own size, utterly helpless, with propeller shaft broken just inside the stern tube and propeller gone by the board. She had been in this condition since the early afternoon, and we promptly made arrangements for taking her in tow, as the captain, of course, scented a rich haul for salvage. We managed to make fast to her without very much trouble, as the sea was moderate, and, after about a couple of hours' delay, we proceeded on our way with the steamer in tow.

Things went fairly well until the next forenoon, when the water tender reported a split in the feed pipe under the floor plates, not far from the feed pump. I was on watch at the time and went immediately to examine the condition of affairs. I found a split about 8 inches long and open nearly a quarter of an inch at the widest part. The feed pump was working at the time, and it was clear to be seen that the water was all going into the bilge and none of it into the boiler. The water tender told me that everything had been working all right a few minutes before, and he had been feeding into the starboard boiler. He thought he had noticed some kind of click, followed by a groaning and laboring of the pump, and then a breaking away as though there had been sudden relief. From later examination it appeared that the boiler check must have suddenly become jammed in some way, and the extra load thus thrown on the pipe first slowed down the pump, and then, when it broke, eased the pressure and the pump started off again. There was no way of getting water into the boilers except from this pipe, and it was very sure that with such a leak in the pipe this would be utterly impossible. I therefore reported to the captain, and we shut down the engine and considered the best way to make the repairs. For our own sake, as well as for the tow which we had, it was absolutely necessary to try and patch things up in some way, so as to reach port as soon as possible and while reasonably fine weather lasted. The feed pipe was copper, and I remembered having seen two or three pieces of sheet copper in the store room. The first idea that came to my mind was to try to solder a strip of copper over the split and reinforce it with a wrapping of wire. I had to give this up, however, because I remembered that we had no soldering kit on board whatever. If we had had a little solder I might have made out in some kind of a

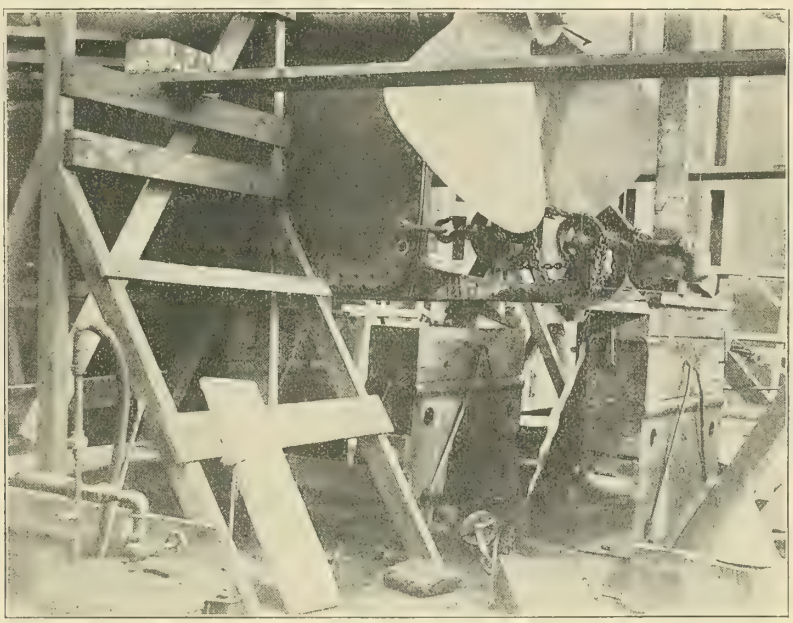


FIG. 3.—METHOD OF REPAIRING STERN FRAME.

way, but there was not a bit of anything of the kind. I didn't know as much then as I have learned since about the power of water to escape under pressure, and so I thought I would try first closing the edges of the split together and then putting on a heavy wrapping of canvas and marline with red-lead putty over the split. So we got together the necessary materials and, after closing the edges of the split down nicely together, put on the wrapping as planned.

In the meantime the fire in the starboard boiler was allowed to die down, the boiler was disconnected and steam was blown off, and the pressure run down so that we could examine the check valve. We found it jammed in the stem near the seat, thus allowing but very small lift and accounting for the extra load suddenly thrown on the feed pipe. This trouble was remedied without very much difficulty, and by the time the

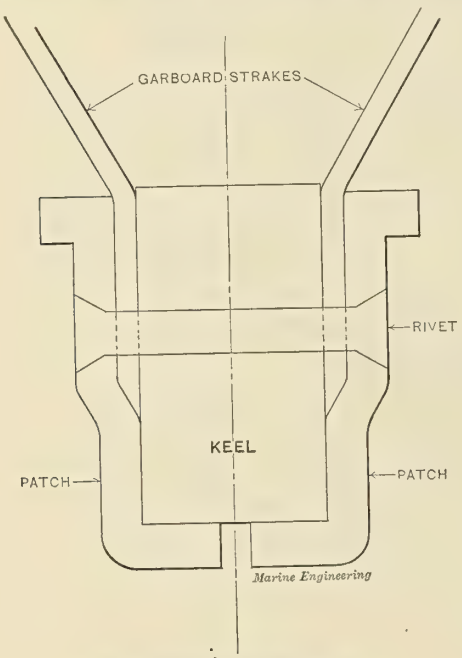


FIG. 4.—PATCHES ON THE KEEL.

wrapping was on the feed pipe the check was closed up again and in good order.

As soon as the pressure was put on the pipe, however, the trouble started in immediately; the marline stretched, the split opened out again, and the condition was nearly as bad as at first. All this might have been foreseen, but I did not sufficiently appreciate the condition I was dealing with. My next move was to substitute a strip of thin copper for the canvas and some light copper wire for the marline. The exchange was made and the new patch was adjusted in about an hour's time. The pressure was then put on the pipe again, and, to my great disappointment, with the same result as before. The copper bulged, the wire stretched, and the water leaked out in streams from all about the edges of the patch. I now began to realize that I was dealing with a situation where some vigorous measures were necessary, and I therefore decided to make a fresh start. The thin patch was accordingly taken off and a somewhat similar one, but made of sheet copper of about gauge No. 10, was formed, somewhat roughly, to fit the pipe, while in the meantime one of the firemen, who was a bit of a blacksmith, made three strap clamps of suitable size to be set up by bolts, of which we found a suitable size in stock. The edges of the split were again closed up, the heavier patch fitted in place and secured by the screw clamps. This time, when the pressure was put on the pipe, the results were very much better. The metal of the patch, aided by the clamps, held its place and the putty did fairly good work in closing up the space between the patch and the pipe. The patch had been rather roughly fitted, however, and there was still a considerable amount of leakage. I was satisfied now, however, that I could master the difficulty and make a good job of the repair, so I removed the patch again and had it more carefully fitted to the form of the pipe, at the same time having a couple of extra straps made. I also hunted up a piece of fine-mesh wire gauze, and cut out a strip the size of the patch as a carrier for the putty. This was then well charged with putty on both sides and placed between the patch and the pipe. The five clamps were then put in place and screwed up, bringing the outer patch, the wire netting, and the surface of the pipe all into close contact. This time, when the pressure was turned on, the result was found to be perfectly satisfactory. The wire gauze assisted in holding the putty in place, and the straps forced the surfaces into such close contact that hardly a perceptible leak could be found.

While we had been experimenting with these various forms of patch the pressure in the starboard boiler had been gradually allowed to rise, so that as soon as we were sure that the pipe would hold we put the necessary feed water into the boilers, and shortly after had the necessary head of steam to proceed on our way.

The feed pipe, thus repaired, gave no further trouble for the rest of the trip, and we succeeded in carrying our tow safely into port, greatly to the satisfaction of the owners of both boats and of all the parties concerned. I may further add that, due to a lack of time for repairs, the *B*——— made two or three trips with the feed pipe in the same condition and without any trouble whatever. Finally, in connection with a somewhat general overhauling and as a matter of precaution, the split portion was replaced by a new section of pipe.

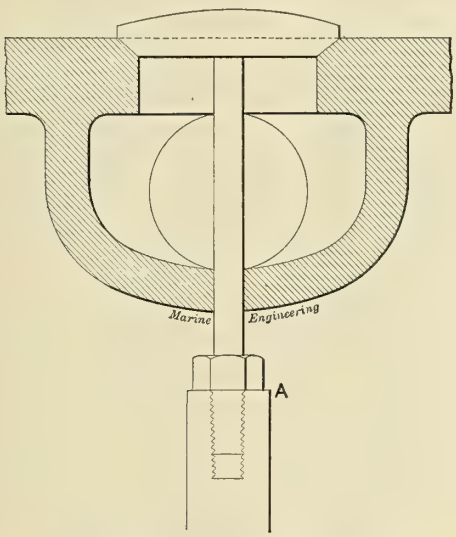
John Leavenworth.

Repairing Gas Engines.

Editor of Marine Engineering:

The readiness with which a gasoline engine can be started, the little skill required to operate it, its cleanliness and the attention it requires while running have made it the most favored of all motive powers for the propulsion of small craft, oyster boats, yacht tenders, etc. Very few yachtsmen would think of purchasing a steam engine and boiler for an auxiliary at the present date, as besides the time lost in preparing the engine for running there is the drawback of constant attendance, which will soon transform a pleasure trip into an unpleasant day's work. The necessity of securing a permit to operate a steam boiler on board of even the proverbial nutshell may also be considered a serious objection to steam power. A good many less ex-

perienced yachtsmen will advocate electricity as a motive power for small boats, but electric launches are confined only to a limited radius about a charging station which excludes them from long cruises. The storage battery also has a limited life, thus making the running expenses of an electric launch rather great. Thus it will be readily understood why the gasoline engine has gained so much favor. The cost of running a gasoline engine is but very small per horse power per hour, and after the engine is started, which does not require any preparation, it needs but little attention. It may also be said that the fuel for these engines can be obtained everywhere and taken aboard very quickly. These facts make this type of motor a universal power, which can be relied upon for a long cruise. But in spite of all the good points these engines have also their faults. The greatest of these faults is the sudden refusal to run, without any apparent reason. Such mishaps are commonly called by yachtsmen "breakdowns"; but as in the majority of such cases nothing serious



EXHAUST VALVE ON GASOLINE ENGINE.

has happened to the engine itself, this is hardly the proper word to use, and in most cases the fault can be remedied in a few minutes by the owner himself.

In one case I saw a man lose his temper to such an extent that he picked up the monkey wrench and struck the engine, which refused to start while he was trying to leave a dock. To my amusement the engine started after this without any further trouble, as soon as the assistant turned the wheel, remarking, "I'll make you go." Now this man did not know why the engine started after this vicious assault, while the fact was simply this: The exhaust valve was operated by a rod, by means of which the exhaust cam would raise it from its seat during the exhaust stroke. Into this rod the exhaust valve stem screwed and was held by a jam nut, as shown at *A* in the cut. This jam nut happened to be loose, and the valve and stem started to turn and unscrew. This probably was caused by vibration and the consumed gases passing through at a very high rate of speed. The valve stem thus lengthened did not allow the valve to seat properly; there was consequently no compression, and the explosions were too weak to run the engine without aid. While the owner was wildly turning the crank, I noticed that he would get a weak explosion only about every four or five revolutions, while the engine should, under normal conditions, have exploded every other revolution, being of the four-cycle type. This was due to the consumed gases being drawn through the partly open exhaust valve, and intermixing with the fresh gases to such an extent as to prevent an explosion.

Now, when this man struck the engine, he happened to land the wrench right on the exhaust rod, causing it to bend, and thus the rod shortened, allowing the exhaust valve to seat, and everything seemed all right. Now if this man would have used a little patience and common sense, he would not have spoiled his day's outing for himself and friends, and would also have saved the repair expense. For, three hours later, the party appeared again in tow of a good-natured oyster man, and landed at the dock belonging to the shop I had charge of and asked for the superintendent. Great was their surprise when the same man who a few hours before had offered to help them out simply as a favor, and whose offer they had rejected, now appeared as the superintendent, and after examining the battered engine politely told them that the shop expenses would amount to $15.00, which they were then willing to pay.

H. E. Raabe.

Points in Setting Up Gasoline Engines.

Some points covering the chief difficulties met with in setting up gasoline engines are mentioned in a communication to *American Machinist* as follows.

Where gasoline is to be used, it should be said at the start that the piping cannot be too carefully done, for gasoline is one of the meanest fluids to pump that there is. Use common soap in making the joints, as gasoline will cut white or red lead, asphaltum and most of the substances generally used for this purpose, and see that you have good threads. I prefer galvanized pipe, although ordinary iron pipe is generally used. Use ground brass unions and have one at the engine and at the tank in both the suction and overflow pipes. The suction pipe must be tight; if it is, and if the check valves are good, the plunger and barrel of the pump are of secondary importance. There should be a check valve at the tank. I put the union between the valve and tank, so that, if the pipe is disconnected when full of gasoline, it will not be wasted. In using gasoline, avoid too rich a mixture, as the combustion will be imperfect and carbon will be deposited on the sparking points. This of course will result in a poor spark, as the current is only sufficient to do the work with clean points. A stronger current is not desirable, as the points would not last. An engine will give more power on gasoline than on natural or artificial gas. Similarly, natural gas is better than artificial.

If a battery is used for ignition, keep it in a warm place, as many cells do not work well at ordinary low temperatures. Always throw the switch when the engine is not running, as otherwise if the engine happens to stop with the points in contact the battery will be on closed circuit and will not last long.

THE PROFESSOR ON SHIPBOARD.

Story of an Attempt to Combine Theory With Practice.

BY C. A. MCALLISTER, FIRST ASSISTANT ENGINEER, R.C.S.

CHAPTER XI.

The days were now passing rapidly. The weather was so hot that the Professor was not in the least anxious to gather any more practical information by going below in the engine and fire rooms, so he spent most of his time during the day lolling around on deck, reading or writing. Occasionally he would talk with groups of his fellow-passengers, and, as a rule, he would interest them greatly, as he was found to be well informed on almost any subject that would arise in the course of the conversation. One of the lady passengers, who had evidently seen at least forty winters, not to mention how many summers, upon hearing that the learned man was a bachelor, became particularly interested in him, and was one of his most attentive listeners whenever he would talk. No matter whom he was addressing, the sprightly spinster would in some way manage to draw her chair close up to where he was sitting. Her attentions became so marked that they furnished a continuous source of amusement to the other passengers. As it gradually dawned upon the Professor that he was the object of her adoration, and not caring particularly for such attentions, he became quite shy and managed to stow himself away in places somewhat inaccessible to his admirer. On several occasions he was inveigled into playing an innocent game of euchre, and one evening he was invited by several sportily inclined young men to take a hand in a game of poker. This he declined with thanks, for, as Barney declared, "He was not the aisy mark that he looked."

Para was to be the next calling place, and speculation was rife as to what time the ship would get there. The poker-playing contingent got up the usual pool as to the time the ship would anchor, and the Professor came up with his five dollars in short order, thus showing that he had some sporting proclivities for a game where he would have an equal chance with the others.

One evening when the ship was nearing her destination the sky in the northwest became clouded, and, as the barometer took a sudden fall, the officers began to make preparations for a blow. The day had been calm and sultry, and the atmosphere at six o'clock was almost stifling. A portentous feeling pervaded the ship, and the Professor, in common with the other passengers, felt as if something dreadful were about to happen. The heavy clouds now almost obscured the sky, and over the starboard quarter they seemed of almost inky blackness. All movable articles about the deck were secured, and the captain and first officers were going around and examining all fastenings and lashings to see that everything was secure. Brilliant flashes of lightning illumined the sky at intervals, to be shortly followed by the deep rumblings of distant thunder. The Professor seemed awe-stricken as he stood by the rail and scanned the approaching storm. A light puff of cool wind struck his face, and at the same moment some one shouted, "There she comes." About half a mile away a dense wall of vapor could be seen whirling toward them in the semi-darkness. So rapidly was it approaching that before the Professor could make up his mind to run for shelter the tropical squall, for such it was, had struck the ship with its full fury. The ship was thrown nearly on her beam ends by the force of the gale, and it was all the poor college man could do to crawl on his hands and knees to his state-room door. Before he could open the door the rain came, and in almost an instant he was drenched to the skin. So heavy was the torrent accompanying the blow that the Professor felt as if a regiment of men were dashing buckets of water over him. The screeching of the gale, the roar of the downpouring rain, the almost incessant and blinding flashes of lightning, together with the terrific thunder, spread terror to his heart. It is safe to say that he would have willingly given up a year's salary to be on *terra firma* at that time. For over an hour the gale continued with unabated fury, and the terror-stricken man hung on and hoped. It was rumored among the crew, after the gale was all over, that he had spent the whole time on his knees praying. However that may be, the storm finally blew over, leaving a cool breeze and a delightful atmosphere, which everybody enjoyed to their utmost. Luckily not even a rope yarn had parted, so the ship proceeded on her voyage none the worse for her encounter with the short-lived storm. The chief engineer informed his brother that such squalls were of frequent occurrence in those latitudes, which information was not relished very keenly by the Professor, who had not fully recovered his equanimity from the trying ordeal which he had just been through.

The ship finally entered the region "where rolls the mighty Amazon," and in due time came to anchor off Para in Brazil. Upon looking over the pool which had been formed, it was discovered that the Professor's guess as to the time of anchorage was within fifteen minutes of the actual moment that the anchor was let go. The money, amounting to fifty dollars, was handed over to him at once, and he was the subject of congratulations from all concerned. He was naturally quite elated at his success as a guesser, but he immediately turned over the money to his brother, the chief, and requested him to divide it up equally among the firemen and coal passers, saying, as he did so, that they were the men aboard that ship who most deserved it.

The anchor had not been down long before the Professor and a number of the other passengers went ashore to see the sights. They did not find Para so attractive as their last stopping place, however, and, with one or two exceptions, all had returned by dinner time that evening. The captain told the Professor that, as there was so much freight to unload, the ship would remain in port for at least two days. The chief engineer, therefore, decided to make some necessary adjustments in the various journals, as the engine was thumping quite noticeably the day or two before they arrived.

The following day the Professor was feeling a little more ambitious than he had at sea, and, thinking that the engine room must be a little cooler than when the ship was under way, he determined to spend a few hours below. As all the men, with the exception of the water tenders, had had all night in, he found them all turned-to either in the fire room or engine room. The high-pressure crank pin had already been stripped, and the

first assistant, with the help of old Barney, was busy scraping away at the brasses. The white metal was in fairly good shape, but the pin was bearing a little too much on the sides of the brasses. This was being eased off, and, after trying the brass on the pin two or three times and scraping down the high spots, it was, in the opinion of the officer, fit to put back in place. The Professor was an interested observer of the various operations of scraping, putting in leads, setting up on the bolts, etc. When the brasses were slacked back and the leads removed, he noticed that the first assistant used an ordinary wire gauge to try the thickness of the leads at different points. The Professor suggested that it would be more reliable if he would use a micrometer caliper for that purpose, stating that the leads were so soft that they could be squeezed into notches below their actual thickness. To an inquiry as to what became of the leads after they were taken, the first assistant replied that he usually put them away in the engine room desk. The Professor then suggested that it would be a good idea to make a sort of scrap book out of brown wrapping paper and have a separate page for each journal. Then, by cutting three slits in the leaf for the pin or bearing in question, the lead could be slipped in place, and the position of the lead and the date it was taken could be written under it. He also suggested that the different thicknesses, expressed in thousandths of an inch from micrometer readings, could be marked opposite the points measured. By this method, he said, you can keep a continuous record of the adjustments on each bearing, and know at a glance just at what time the last adjustment was made and to what thickness the bearing had been set. The first assistant replied that he considered the college man's suggestion a good scheme and that he would get up such a book at once. After the high-pressure pin had apparently been properly adjusted, he noticed old Barney take a pinch bar, and, getting a nip between the side of the brass and the crank web, he gave it a sudden jerk, whereat the brasses gave a chug up against the after crank web.

"Now I know she's all right," said Barney. "I don't take much stock in them Mike Romets, or whatever it is you call 'em, but when you can move her with a bar without busting a suspender, she's all right."

The Professor was quite amused at Barney's philosophy, and concluded that for practical methods the old Irishman evidently knew his business. After they had finished with the high-pressure pin, they commenced preparations to raise the cap on the forward main bearing. While this was going on the Professor walked over toward the feed tank, where he saw a man removing a lot of dirty, greasy excelsior. In answer to a question, the chief, who happened to come around at that time, replied that the excelsior had not been removed since they left New York. To this the Professor remarked that, so far as filtering was concerned, the tank had not been of any service after the first three days out. The chief replied that he supposed that it had not, but informed his brother that the filtering material was so arranged that it was difficult to renew it while the air pump was in operation. The Professor suggested that it would be well to put it in bags or other compact form so that it could be pulled out easily. Continuing, he said that unless the discharge water was kept as cold as possible this form of filter tank was of comparatively little use, as the particles of oil in the water will not congeal and settle on the filtering material if the water is kept at a temperature much over 80 or 90 degrees.

"Of course," said he, "as you have no feed-water heater here, you naturally try to keep the hot well at as high a temperature as possible, consistent with a good vacuum. That is only an additional reason why a feed-water heater should be fitted on every vessel." Continuing, he said that he did not know of any very efficient filter on the market at the present time.

"I have had an idea for a long time," said he, "that eventually some one will devise a filter wherein the particles of oil will be removed from the feed water by centrifugal action similar to the manner in which they separate cream from milk in large creameries or cheese factories. This separation of the oil from feed water is one of the most important problems before the marine engineer to-day, and especially so since the water-tube boiler is so rapidly coming into use."

The chief agreed with him that this was a very important subject, and he said that he hoped some efficient device would be gotten up for the purpose.

"There is one little detail I want to call your attention to about feed tanks," said he, "and that is, if you ever have anything to do with getting one up, don't put one of those fancy float valves over the suction to the feed pump. I had one in here and ripped the thing out the very first trip I made with it. They work all right on paper, but they are bound to hang up or get out of order just when you least expect it. It's all rot to think that you are going to pump air into the boilers if you don't have such a valve. If I had a water tender, and he couldn't tell in an instant by the action of the pump that the tank was nearly empty, I'd fire him on the dock quicker than a snowball will melt in the lower regions. Then, too, I've seen a float rigged up so as to throttle down the pump when the tank gets empty. That's another crazy scheme; it may work all right on some tugboat around a harbor, but no such contrivance for me on board a seagoing vessel. If some of these youngsters who work in a draughting room and spend a lot of their time inventing such contraptions could go to sea and try to run them they would not be so anxious to get up such labor-saving (?) devices."

The Professor replied, quite warmly, that seagoing engineers were indebted to just such young fellows as he described for many of the greatest improvements they had around marine machinery. The chief said, bluntly, that he didn't believe it, and the Professor, not caring to continue the argument, let the matter drop, but clung to his own opinion. The chief, however, continued his growling and said:

"Now if some of your smart alecks want to get up something useful, let them invent a rig that will warn the water tender when the feed tank is nearly full, so that the water will not be wasted by running over into the bilge." The Professor replied that that was a very easy proposition.

"Why," he said, "just rig up a float so that when it rises to the top of the tank it will make an electrical connection and ring a bell in the fire room."

"There you go with your old float again," growled the chief.

As he was evidently down on floats, the Professor concluded to stop suggesting anything in that line. They walked around the engine room together, occasionally getting into an argument, and sometimes agreeing. At one stage of the conversation the Professor asked his brother why he did not have some system of painting the various parts of the machinery.

"If you want to know of a good system I will describe one for you," said the Professor. "Well," replied the brother, "your painting system may be all right, but I'm more interested in getting something to eat just at present, so let's go up to lunch and we'll talk about that afterward."

The two brothers then walked out of the engine room, and Barney, who observed the difference in their physiques and had overheard some of their arguments, remarked to one of the other oilers that "thim fellers will never get a job in a circus as Siamese twins."

QUERIES AND ANSWERS.

Q.—How are dimensions of commutators determined? Large generators have larger commutators than small ones, but I have not been able to find out whether the increase in size is made simply to make it in keeping with the increased size of the other parts, or whether it is actually necessary to make the commutator larger. If it is necessary to make the commutator larger, why is it, and how are the diameter and the face calculated? V. K. S.

A.—In large machines the commutator is made larger than in small ones because it is necessary, and not simply for the purpose of making a harmonious design. The number of commutator segments is determined by the voltage of the current, and by the number of poles. If the number of segments is reduced below a certain point, the sparking is liable to be severe. On general principles, the greater the number of segments the less the sparking, but by skilful designing the sparking can be greatly reduced for any given number of segments. As an average rule the number of segments can be estimated as equal to the voltage divided by ten and multiplied by the number of poles. This rule is used to determine the smallest number of segments permissible; thus, if the voltage is 100 and the machine has six poles, the number of segments in the commutator would be 60, or as many more as other conditions would permit. The diameter of the commutator is determined by the number of segments, and by the size of the armature wire, each segment having to be wide enough to be drilled or grooved at one end to receive the armature wires. The face of the commutator is determined by the strength of current, which latter determines the area of brush that must be in contact with the commutator to transmit the current without overheating. For carbon brushes the brush area is calculated at about one square inch for every 40 amperes of current, so that if the segments are one-third of an inch wide, the brushes will have to be three inches long if the current is 40 amperes, and this would make the face of the commutator about three and one-half inches.

Q.—We have a twin screw tug with compound engines, 15 inches and 30 inches by 22-inch stroke, carrying 125 lbs. steam; steam is supplied by two Scotch type boilers 11 feet 6 inches by 129 inches diameter, with two furnaces each 44 inches diameter by 8 feet 7 inches long. Each boiler has 153 tubes 3½ inches in diameter, and the grate bars are 88 inches long. The tops of the bars are 22 inches from the top of the furnace at both ends, and we have 13½ inches over our bridge wall.

Would these boilers make more steam or be more economical with shorter bars and the back ends lowered or not? Can you suggest anything that would be an improvement in her steaming or economy? E. R.

A.—From the data which you give it appears that you have about 54 square feet of grate surface and 1,415 square feet of heating surface in each boiler. This gives you a ratio of about 26 to 1. This ratio is low and you cannot expect an efficient performance of the boiler with anything approaching a fair rate of combustion per square foot of grate surface. It would undoubtedly be better to shorten your bars to about 5 feet 9 inches in length, thus giving you 42 square feet of grate surface and a ratio of heating to grate of 33.7. A grate 88 inches long is altogether too long for efficient work, and it is very sure that the back part of the grate is of relatively small value. You will probably be able to better burn your coal on the shorter grate than on the longer.

Regarding the height of the grates the data which you give indicate an area of about 2.7 square feet over the bridge wall for each furnace. This is rather small, and it is likely that the boiler would operate more efficiently with a somewhat increased size of passage at this point. It would probably be advantageous to lower the grate bars at the back end by about 3 inches, thus giving a height of 16½ inches over the bridge wall and increasing the area to about 3.6 square feet. Without more definite data regarding the actual performance of the boiler it would be difficult to recommend any other changes. From the proportions given, however, it seems likely that those above recommended would increase the economy of boiler under the conditions prevailing in ordinary practice.

Q.—Supposing you have a dynamo that gives 100 volts, how can you determine the amount of the current that will flow through any wire or lamp or motor? If you connect an incandescent lamp to the two wires running from the binding posts of the machine, and then connect a motor by the side of the lamp, the motor will take a great deal more current than the lamp. Now what makes one take more current than the other, and if there is a way of finding out what each one will take before connecting it to the machine, how do you do it? J. T. C.

A.—The flow of current in electric circuits is governed by Ohm's law, which is the A B C of electrical science. According to this law, the strength of the current flowing in any circuit is equal to the voltage divided by the resistance. The resistance is measured in ohms, the current strength in amperes, and the voltage in volts. Suppose the voltage is 80, then if a lamp having a resistance of 100 ohms is connected with the two wires, the current passing through it will be equal to 80 volts divided by 100 ohms resistance, and this is 8-10 of one ampere. Now, suppose we have a motor through which the current is 40 amperes, then the resistance offered by this motor to the flow of current through it is equal to 80 volts divided by 40 amperes, which is two ohms. In the case of a motor, the current that passes through the shunt coils wound upon the field is directly proportional to the voltage divided by the resistance, but with respect to the armature current the strength is not determined so readily. The motor armature, when in motion, develops a counter pressure, which, like the direct voltage, is measured in volts, so that to determine the true pressure acting to force current through the armature, we must deduct the counter from the direct voltage. Thus, in the case cited above, suppose the counter pressure of the motor is 75 volts, then this deducted from the 80 volts of direct pressure leaves a net pressure of 5 volts. Of the 40 amperes that pass through the motor, suppose that 2 pass through the field coils, and 38 through the armature, then as the net pressure acting in the armature circuit is 5 volts, the resistance of the armature is equal to 5 divided by 38, or nearly 132-1000 of an ohm. As the current through the field coils is 2 amperes, and it is forced through by the full 80 volts, the field coil resistance must be 80 volts divided by 2 amperes, which is equal to 40 ohms. By the same process the strength of current that flows through any circuit can be determined.

Q.—Please give me the United States Government rule how to find the distance from the fulcrum a given weight is required to be placed to allow the valve to rise at a given pressure to a lever safety valve.

A.—The Government gives no rule for the solution of this problem. It is a problem which must be solved by the principles of mechanics. The following rule is based on these principles, and will enable you to solve such problems.

Multiply together the pressure per square inch, the area of the valve in square inches and the distance from the center of the valve spindle to the center of the fulcrum. From this subtract the product of the weight of the valve and spindle by the distance from the center of the spindle to the center of the fulcrum, and also the product of the weight of the lever by the distance from its center of gravity to the fulcrum. Having subtracted these two quantities from the original product, divide the remainder by the given weight. The quotient will be the distance of the weight from the fulcrum.

Q.—What is the distinction between a gas and a vapor and to which does steam belong? What is supersaturated steam? J. C. B.

A.—We suppose that you understand the three states in which matter may exist—solid, liquid and gaseous. To fix our ideas, however, we may remember that matter is considered to be composed of very small particles called molecules, all of which are supposed to be in a state of more or less violent agitation or motion. If the motion of each molecule is about a fixed center, or if it is supposed to remain in a fixed part of the body, then the body in such condition will retain its shape and is what is usually known as a solid. If the molecules are, however, free to move about one with reference to another so that the body readily changes form, it is said to be a liquid or in the liquid state. If the motion of the molecule is in straight lines hither and thither, bound to no fixed locality and always striving to get as far apart as possible, the body can be said to have no shape or form, as it is always trying to expand to a larger and larger volume. In such case the substance is said to be a gas or in the gaseous state.

You also remember that a change of state from solid to liquid or liquid to gaseous is usually brought about by the addition of heat accompanied by a change of volume. Now when a substance first changes from the liquid to the gaseous state in general, or, in other words, while the pressure, volume and temperature are very near the values which correspond to such a change, the substance is usually called a *vapor* or is said to be in the vaporous condition. A substance in the so-called gaseous condition is understood to be at a point regarding pressure, volume and temperature, far removed from the locality corresponding to the change of state from a liquid. There is no sharp line between a vapor and a gas. The former simply means a substance in the general gaseous state, but very near, as regards pressure, temperature and volume, the condition of change from a liquid; while a gas means a substance in the general gaseous condition and very far removed from the pressure, temperature and volume corresponding to the change from a liquid.

Steam as ordinarily used is a vapor simply because its volume, pressure and temperature are very close to that corresponding to a change of state from water. In fact steam in the ordinary state is actually at the point of change, and any decrease in temperature or increase of pressure would result in a certain amount of steam passing back into the liquid condition.

Steam in this condition is said to be *saturated*. If, however, saturated steam is heated out of contact with water so that its temperature and pressure for the same volume become higher than the values for saturated steam, it is said to be *superheated*. In general, superheated steam may be defined as steam having a pressure and temperature for a given volume higher than the values belonging to saturated steam. From the preceding definitions it is clear that as we begin to heat saturated steam in this way we begin to carry it toward the gaseous condition. So long as it is slightly superheated we may still call it a vapor; but highly superheated steam, being carried far away from the saturated condition, is more properly called a gas.

The word saturated may be somewhat misleading, having in view its ordinary meaning. Saturated steam contains no water whatever. It is simply pure steam, just as it is formed from the water and ready to change back with any increase of pressure or decrease of temperature as noted above. On the other hand, *supersaturated* steam implies simply a mixture of saturated steam and water. It may be remarked that superheated steam and water will not remain together in equilibrium. The steam will give up part of its heat and come down to the saturated condition, while a small additional quantity of water will be vaporized. Saturated steam and water may, however, be mixed and remain in equilibrium, and such steam containing in suspension a certain amount of water is said to be supersaturated.

Summer Meeting.—The summer meeting of the Schiffbautechnische Gesellschaft was held from June 2 to 5, 1902, at Düsseldorf, Germany. The most interesting programme was carried out, including papers read on topics of interest to shipbuilders, and excursions to various sections of shipbuilding and manufacturing industry. Members of the Society of Naval Architects and Marine Engineers were invited to attend.

ENGINEERS' DICTIONARY.—XXXVII.

Racing. The pitching and 'scending of a ship in a seaway cause wide variations in the immersion of the propeller. At one instant it may be almost entirely out of the water and the next deeply immersed. With constant steam pressure this will lead to an extremely violent and irregular motion of the engine, known as *racing*. Various forms of marine governors have been proposed and are in use, to some extent, for the purpose of controlling this condition. See further under **Governor.**

Radial—Float, Wheel, Paddle Wheel. See under **Paddle Wheel.**

Receiver. In a multiple-expansion engine the space between the valves of two successive cylinders is known as *receiver* space. In some cases a special chamber or receiver is thus provided, into which the steam in one cylinder is exhausted before it enters the next following. In most cases with modern marine engines having three or four cranks, however, no such special volume is required, and the receiver space consists simply of the exhaust passages and piping between the valve of one cylinder and that of the next following.

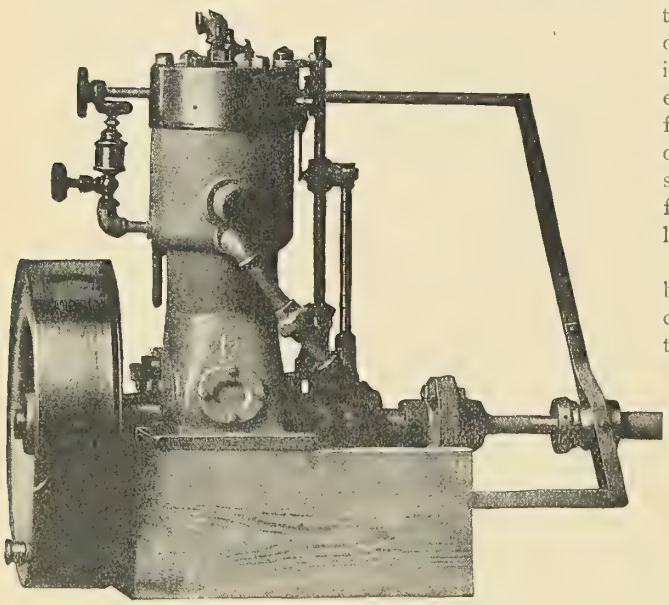
Relief Cock—Valve. A cock or valve fitted to a steam engine cylinder, and intended to relieve the cylinder of water which may enter with the steam. There are two varieties of such relief valves, those which are operated by a lever under control of the engineer, and those which operate automatically under a certain excess of pressure. The latter consist, in effect, of a special type of spring-controlled safety valve and operate in the same general way. When an engine is first started up under steam, or in case the boilers should foam or prime, considerable quantities of water may find their way into the cylinder. If there were no means of removing such water there would be danger of breakage or serious damage to some of the parts. It is for the purpose of removing the water and guarding against the danger of such damage that relief valves are fitted.

Resistance. For the marine engineer this term has chief reference to the resistance which opposes the motion of a ship through the water. It is the business of the screw propeller or paddle wheel to develop a forward thrust which shall overcome this resistance and thus insure the movement of the ship as desired. The resistance of a ship is usually referred to under two heads: the *skin resistance* and the *residual resistance.*

The skin or frictional resistance is that part of the total resistance which is supposed to be due to the mutual action between the skin of the ship and the surrounding water. Due to this mutual action, the water in the immediate vicinity of the surface is thrown into confused eddies and whirls composing a kind of surrounding blanket of water. Work is required to generate and maintain this blanket of eddying and whirling water, and the resistance which it occasions is therefore known as the *skin* resistance, and sometimes, from its analogy to the surface effect between solid bodies, as the *frictional* resistance. In addition to the skin effect, consisting of the surrounding blanket of eddying water referred to above, the movement of a ship through the water produces a series of other effects, chiefly represented by waves and distributed surface disturbances reaching to a considerable distance from the ship. To

generate and maintain such a system of waves and like disturbances work is also required, and the resistance which this occasions is known as the residual or wave-making resistance.

In this view of resistance the two kinds are classified in accordance with the character of the disturbances which are produced in the water. A different and perhaps juster view of resistance may be obtained by considering it as due to a disturbance of the surface pressures acting between the water and the ship. When the ship is at rest these pressures or forces all act perpendicular to the surface. When there is relative motion the total force acting between the ship and water is no longer perpendicular to the surface. It will have, therefore, a perpendicular component or part, and also a component or part lying along the surface.



TWO-CYCLE MARINE GASOLINE ENGINE.

The total action, therefore, may be viewed as the result of these two forces acting between the water and the surface of the ship, one of which acts perpendicular to the surface and the other along the surface. The former may be considered as the cause of the waves and distributed surface disturbance, while the latter is the cause of the skin effect. This view, therefore, serves to connect the two methods of considering the resistance as a whole. The actual resistance of a body to movement through a liquid is very imperfectly understood. It seems to depend upon so many obscure conditions, and the influences of these seem to be related in such intricate ways, and our knowledge of the internal constitution of a liquid is so imperfect, that up to the present time there is no satisfactory theory capable of dealing with this problem, and in consequence reliance is chiefly placed upon the results of experience and of direct experimental research upon small models.

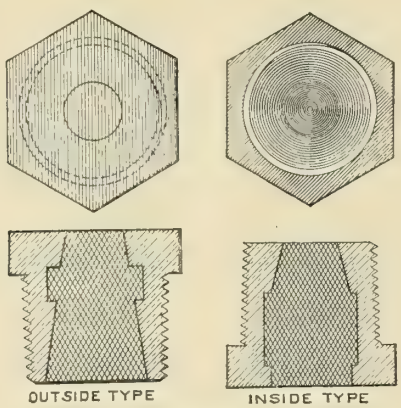
Rules for Launches.—The Treasury Department has decided that naphtha and gasoline launches shall come under the class of steam launches in regard to the signal lights which are to be carried.

ENGINEERING SPECIALTIES.

Two-Cycle Marine Gasoline Engines.

There are many difficulties to be found in the two-cycle type of gasoline engines which have in the past condemned it for general use. Among the essentials of a good engine of this class are: First. It must have a good generating valve that will give a correct mixture. Second. The crank case must be tight and of the least cubical capacity, with shaft bearings packed to avoid leakage, so that from 4 to 6 pounds crank-case pressure may be obtained at each stroke. Third. The piston must be properly fitted and packed so that it will not drag heavily, due to heating, but will give a compression on the up stroke. Fourth. There must be a proper sized direct passage to transfer the mixture from the crank case to the cylinders, and there must be a well-designed baffle plate fitted close to the walls of the cylinder. Fifth. The cylinder head must be properly jacketed and properly shaped on the under side so as to form a return bend for the incoming mixture to thoroughly drive out the burnt gases of the preceding stroke, and free from square corners or pocket the different gases. Sixth. The igniter must be simple, reliable, and durable, whatever type is used.

These points are all claimed for the gasoline engine built by John F. Kemp, Quincy, Mass. Forged steel crank shaft and bronze bearings are used, and the materials and workmanship throughout are of the best.



TWO NEW TYPES OF FUSIBLE PLUGS.

Fusible Plugs.

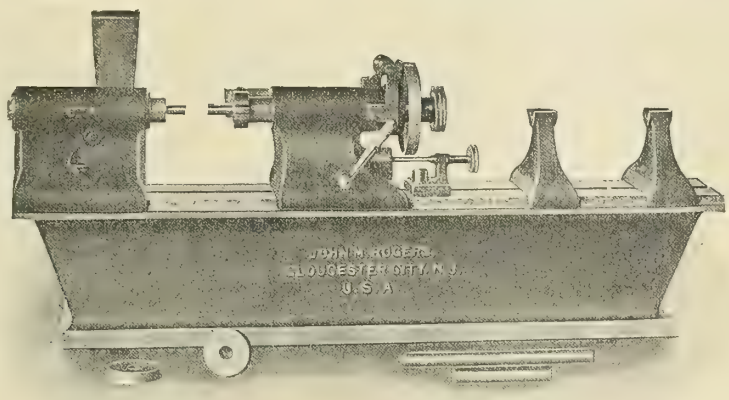
The recent action of the United States Treasury Department in enforcing the provisions of Section 4436 of the United States Revised Statutes, regarding the specifications as to the manufacture of fusible plugs, has attracted considerable attention to this boiler fitting. Fusible plugs have been used in boilers for a great many years, and the Government, recognizing the important function of this accessory, requires that all plugs used on boilers of steam vessels should be made of bronze and have no other filling but pure Banca tin.

Many plugs have been offered on the market which are filled with fusible alloys composed of other metals. which, although melting at very near the same point as Banca tin, are not absolutely reliable. Since the disaster at Philadelphia last fall, the United States Steamboat

Inspection Service of the Treasury Department has taken cognizance of the fact that inferior plugs were offered upon the market, and issued a circular requiring that all fusible plugs should be filled with pure Banca tin and stamped with the manufacturer's name, and that an affidavit setting forth this fact should be filed with the inspector having charge of the boiler inspection at whatever point the plugs were used.

The Lunkenheimer Company has manufactured fusible plugs for a number of years, all of which comply with these specifications, and, having made affidavit before the United States Steamboat Inspection Service, to the effect that these plugs comply with these requirements, the same are accepted by all inspectors throughout the United States. Herewith are illustrated two forms of plug, namely, the outside and inside patterns, same to be screwed in either from the inside of the boiler or from the outside through the fire box or shell.

These plugs are manufactured by the Lunkenheimer Company, of Cincinnati, Ohio, who will be pleased to give further particulars upon application.



STANDARD MEASURING MACHINE.

A New Measuring Machine.

A new standard measuring machine has been recently developed by the John M. Rogers Boat, Gauge and Drill Works, of Gloucester City, N. J. On this machine a system of multiplying levers is used for gauging the pressure on the test piece, being measured so as to eliminate the personal factor. An indicator is placed at the left hand end shown in the vertical case, and is made up of a series of levers, one of which is connected to the spindle in the head of the machine. By the use of these levers, the slightest motion of this spindle is multiplied many times and communicated by lever seen through the top end of the case.

In order to set the dial of the machine at zero, which operation must be carried out before any work is measured, the measuring points are brought into contact, the movable head is clamped in position and the measuring screw is turned, thus giving movement to the system of levers. This is continued until the graduation mark on the end of the lever coincides with the mark on the case. The index pointer of the graduated dial on the movable head is then set to zero. The spindle on the index head can then be run back and the operation be repeated an indefinite number of times and by different operators, and the two indexes will come to zero simultaneously. The movement of the upper end of the lever is so great in proportion to the movement of the spindle that the machine is extremely easy to operate and at the same time very sensitive. The machines are built in two sizes, viz., 0 to 12 inches and 0 to 24 inches, and they are also furnished to measure in the metric system.

A New Windlass.

The schooner *Perry Sutzer,* building at Bridgeport, Conn., is to be equipped with a new style of yielding, non-breakable windlass, which is specially valuable in the equipment of sailing vessels. One of the great disadvantages on board a large schooner with the ordinary form of windlass is that if the vessel is caught in rough weather, so that she must anchor in an exposed place, there is always the danger that the chain will part or the windlass break.

The captains of vessels have, for this reason, hesitated to anchor, and so have preferred to lie-to and ride out the gale or storm. But this is a dangerous proceeding, for when these large schooners are under short sail, as is necessary in very heavy weather, it is impossible to keep them head to the wind; in fact, they "fall off broad," and much of the time are actually lying in the trough of the sea, which every sailor knows is the most dangerous position to put any sailing vessel in.

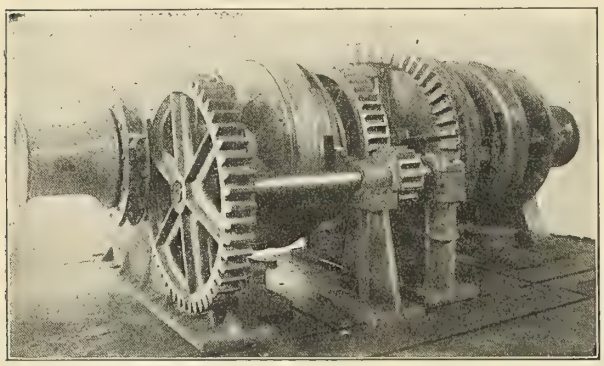
The danger of anchoring is eliminated on vessels equipped with these yielding, non-breakable windlasses, which will securely hold the chain, and yet allow it a certain run when excessive strain is brought to bear. The windlass shaft is mounted on three bitts, and carries two wildcats, two friction brakes and spring heads, two positive driving heads, two gypsy ends, and one starboard bevel gear and one bevel gear spring head. Each wildcat is provided with suitable pockets on the inner flange for the reception of springs.

Each friction brake and spring head has a positive locking device, worked by raised cams on the periphery of a locking ring and slotted block keys, and operated by means of a lever. The block keys are in full sight of the man operating the windlass, and the entire operation of locking or unlocking the windlass is accomplished by one motion of one lever through an angle not

exceeding 60 degrees. The wildcat is controlled by a friction band brake on the friction brake and spring head, and operated by a cam and lever arrangement. Each wildcat can also be locked fast to the friction brake and spring head by means of block keys.

The capstan is driven from the windlass shaft by means of bevel gears. The pinion gear is loose on the upright shaft, and is driven by means of a suitable clutch, so that the capstan can be worked without turning the windlass.

The bevel gear for driving the capstan is provided with suitable pockets for the reception of springs, and the bevel gear spring head is also provided with such pockets placed opposite to those in the bevel gear. There



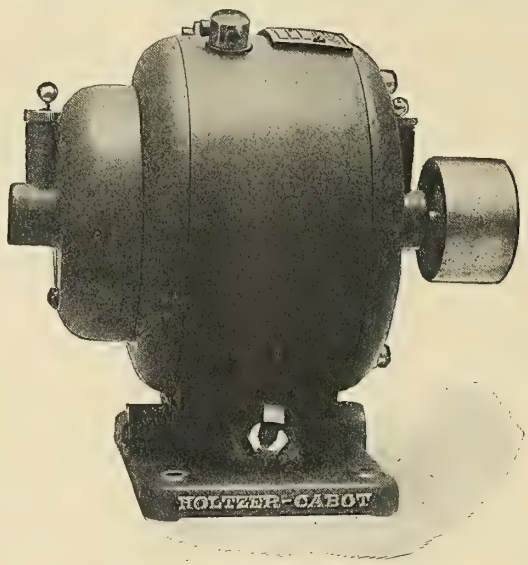
A NEW TYPE OF HAND WINDLASS.

is a suitable amount of space left between the lugs in which these pockets are formed, so as to allow these springs to compress when the strain on the chain is such that it has compressed the springs in the wildcat. In the opposite end of these spring lugs is also placed a suitable rubber spring to take the rebound which occurs where the strain is suddenly relieved. The bevel gear can also be locked fast to the head by means of block keys. The bevel gear spring head also carries the ratchet which holds the windlass from turning backward, and therefore the total strain on the chain is divided between the springs in the wildcat and the springs in the bevel gear.

This windlass is built by the American Ship Windlass Company, of Providence, R. I.

Gas Engine Igniter.

The Holtzer-Cabot Electric Company, Boston, Mass., has recently designed and placed on the market a new gas engine igniter of the dynamo type, which presents some novel and distinctive features, the most important of which are found in the fact that it does not require the use of a spark coil and is quite independent of speed, the latter feature overcoming the great objection to the dynamo type of igniter. There have been of late great advances made in the size of gas and gasoline engines, while the best practice seems to incline toward the multiple cylinder. These engines, by reason of the nature and volume of the body of gas to be ignited, the high frequency of the spark and also on account of peculiarities in the construction of the make-and-break device, require a large and practically continuous flow of current to produce satisfactory ignition. It is well known that the strength of magnetization obtainable in the best permanent magnets is for a given weight relatively quite small in comparison with that which may be secured with an electro-magnet. It is evident then, that a machine of the permanent magnet type, constructed to deliver any considerable amount of energy, would be unnecessarily large and heavy. This igniter has been, therefore, made of the dynamo type for the reasons given. It weighs 19 pounds, and will, if necessary, deliver continuously a maximum output of 50 watts. As stated the dynamo is practically independent of speed, and at 1,000 R. P. M. will deliver ample current for satisfactory ignition, while the speed may be increased to 2,500 R. P. M. without danger from burning out. Thus the igniter may be driven from the flywheel of the engine with the ordinary belt or friction pulley. The field core is of a solid casting of soft steel, and the armature is of the drum type carefully laminated and wound with double silk-covered magnet wire. The shaft is of high-grade steel and the bearing sleeves are of phosphor bronze. The brush holders and commutator are large and heavy, while the brushes are of a special composite structure, combining the substantial qualities of carbon with the higher conductivity of



DYNAMO TYPE GAS ENGINE IGNITER.

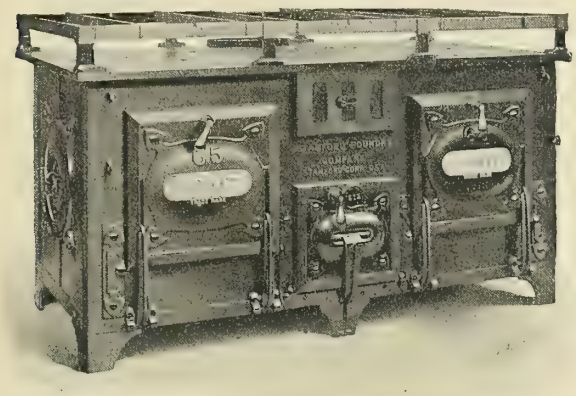
copper. The machine is rendered quite impervious to dust and moisture by a protecting shield, which fits over the commutator and brushes. This may be easily removed, making the brushes and commutator readily accessible. The body of the machine is mounted on a light-hinged base in such a manner that a wide range of adjustment may be effected without using sliding contacts or clamping nuts.

Galley Range for Steam Ships.

There is one thing that the captains and stewards of the sailing vessels of our merchant marine are familiar with, and that is the Shipmate range in the galley, for this range is probably in use on more of our sailing vessels than any other range, or perhaps than any other two or three ranges combined. Many steam vessels, as well, use the Shipmate; but heretofore large steam

vessels have been prevented from using it because the largest size of the range was too small for their requirements. To overcome this difficulty the number 65 Shipmate has been made.

This is a five-foot, two-oven range suitable for cooking for from 65 to 75 persons, according to the requirements. The matter of durability has received careful consideration in its construction, and the range is made very heavy, to stand the hardest kind of use. The top is composed of removable plates, the section immediately over the fire having two rings and a small cover. By an invention patented by the makers of these ranges the grate-frame is dispensed with, and the bricks lining the fire-box are independently supported and have their lower edges protected by heavy guard strips, which are not disturbed when the grate is removed or changed. The guard strips are taken out or put in without disturbing the bricks or even loosening a bolt. Each down flue has an independent damper, by means of which the amount of heat going to each oven can be closely regulated, and nearly all of the heat can be thrown to either oven if desired.



A SHIP RANGE.

The doors all drop and are supported horizontally, when open, by strong braces, which will sustain several hundred pounds. The ashpit door can be opened sufficiently for draft without extending into the room, or can be let down to a horizontal position when ashes are to be removed, forming a hearth preventing littering the deck. The Stamford Foundry Company, Stamford, Conn., will be pleased to send, free, a catalogue giving full description of this and the other sizes of Shipmate ranges, together with a list of their numerous Shipmate agencies.

The Simplex Water-Tight Electric Fixture.

A novel water-tight electric light fixture has recently been placed on the market by R. E. Kirk, Jr., Company, of 210 Patterson street, Baltimore, Md. The most striking feature of this fixture is the elimination of the objectionable outer glass globe (commonly used on other types of marine fixtures), by a self-adjusting water-tight joint made directly on the lamp or attachment inserted in the fixture. By this means the lamp is held gently but firmly in its proper position, making it impossible to jar or shake out. This also "cushions" the lamp against unusual shocks, reducing breakages to a minimum. Part of the weight saved by the elimination of the outer glass globe is put into the construction of the shell and guard, both of which are capable of withstanding the roughest handling. The guard is cast, which is another departure from the conventional method of making this important protection to electric lamps. By casting the guard the use of soft wrought brass and numerous rivets is done away with, besides making it stronger and more serviceable. This fixture

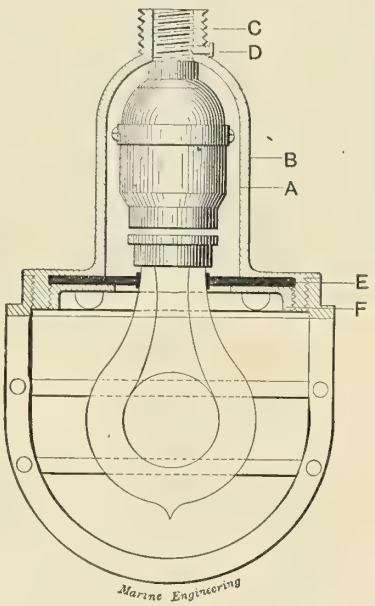


FIG. 1.

is made for use in any of the numerous shapes and positions demanded by the trade. The makers claim it to be absolutely water-tight, each fixture being thoroughly tested before leaving their works.

By consulting the accompanying cuts a clear conception of the above features may be obtained. In Fig. 1 is shown a type A fixture in section as used for pendants on conduit work.

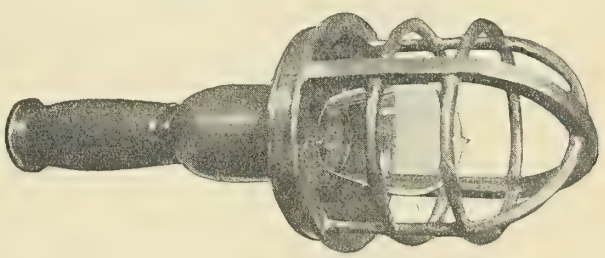


FIG. 2.

The bell-shaped shell *B* completely surrounds the socket *A*.

The socket is connected to the shell by the threaded nipple *C*, which is held firmly in place by the screw *D*. An elastic packing *E* is clamped securely to the bottom of the flange of the shell by the adjustable packing ring *F*. An opening is cut in the center of the elastic packing, just large enough to allow the base of a lamp to pass through snugly. As the lamp is screwed into the socket, the internal pliable edge of the packing grips the neck of the lamp firmly, at the same time adjusting itself

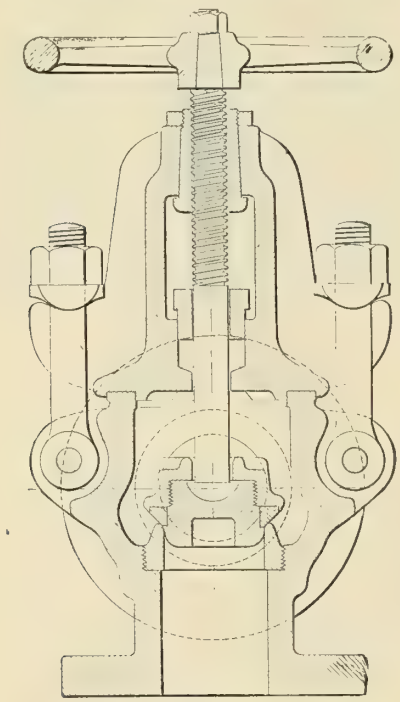
to any irregularity in the structure of the lamp, thus making a water-tight joint.

Fig. 2 shows the type A portable fixture, which is fitted with a hardwood handle, and a stuffing box with the standard stuffing rubber to make a tight joint with the cable.

Both the above type fixtures are fitted with standard keyless sockets of Edison, T. H., or Westinghouse type.

Heavy Blow-off Valves.

The valves here illustrated are suitable for blow-off valves on high-pressure boilers, and are designed for a working steam pressure of 250 pounds per square inch, having a factor of safety amply large to cover the stresses due to such service. They are made from extra



SECTION OF A HEAVY BLOW-OFF VALVE.

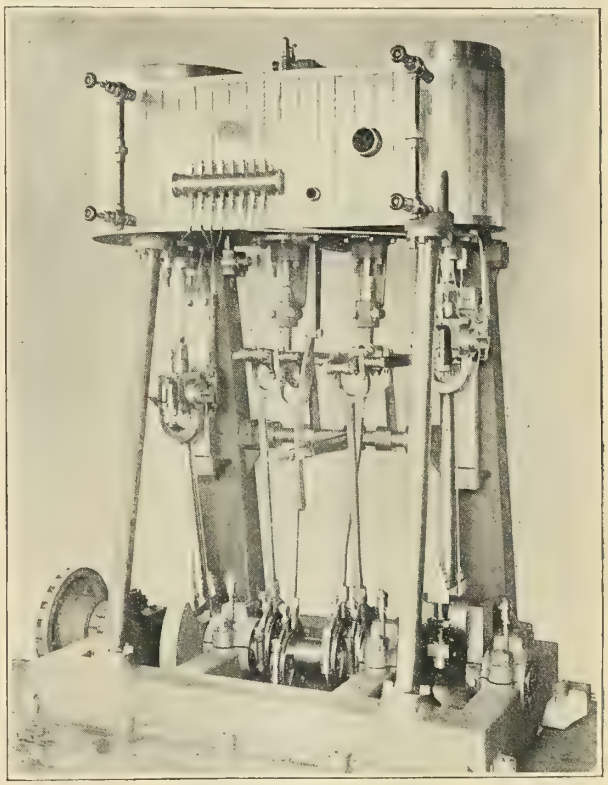
heavy patterns, have iron bodies, caps, and wheels, renewable bronze seat rings, bronze spindles with outside screw, and the self-packing feature enables them to be packed while open. The valve disc has a renewable soft metal ring, which can be easily changed by removing the piston portion of the valve disc. These soft metal rings are cast in a metal mold and require no finish.

The bronze seat rings can be easily taken out of the body and refaced, in case they become worn or injured. The body and cap joints of these valves are made with flanged, tongued, and grooved joints, held together by two large swivel eye bolts made fast to the body of the valve, thus forming a very reliable method of making body and cap joints tight, and permitting them to be easily taken apart to renew the valve seats. These valves are made with flanged ends, and are fitted with bolt following stuffing box packed ready for use. Further particulars should be addressed to the manufacturer, The Chapman Valve Manufacturing Company, Indian Orchard, Mass.

Compound Marine Engine.

A compound marine engine has recently been built by Jas. H. Paine and Son, Boston, Mass., for the Damariscotta Steamboat Company, and of which a brief description follows.

The engine is a fore and aft compound, having cylinders 10 inches and 20 inches diameter with a stroke of 14 inches. The steam chests, which are steam jacketed, are both between the cylinders, with faces bolted together, thus forming but one chest which contains both valves with suitable partitions between. Piston valves are used in both, with the H. P. taking steam in the center and exhausting over the ends into the L. P. chest or receiver, from which the L. P. valve takes steam over



COMPOUND MARINE ENGINE.

the ends and exhausts in the center. This arrangement of cylinders obviates the use of the usual long outside receiver pipe and also does away with the overhung and unsupported steam chests, and enables the engine to be placed close to the aft bulkhead, as there are no parts here which require access.

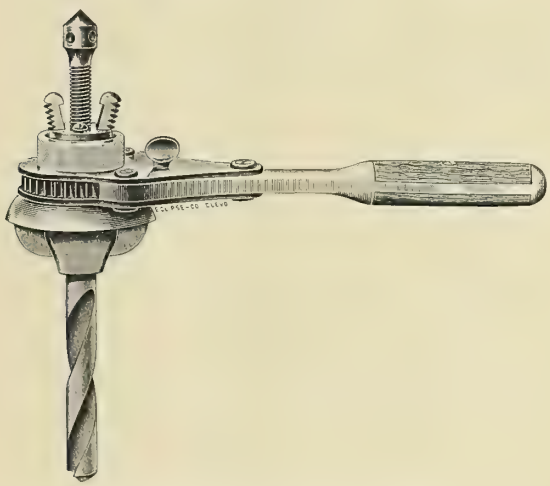
It was also wished to increase the length of the main journal bearings and crank pins with the same over all length of engine. The main journal bearings were thus increased 5 per cent. and the crank pins 10 per cent., and the same over all length retained.

The front of the engine is made open, there being but the two straight columns, so that all parts are directly under the eye of the engineer, and all bearings are within reach. The main steam and by-pass are placed close together, so that there is no reaching for steam valves. The crosshead is of bronze with wrist box inserted, while the crosshead guide is of cast iron and of the

single bar type, secured to the back frame, so as to be taken down without removing crosshead or connecting rod. The links are of the double bar type, and the valve gear is adjustable in all its parts. The reverse shaft is placed between the back frames, which brings it entirely out of the way. The oiling service is very complete, and consists of oil boxes cast on main journal caps and fitted with hinged covers; grease caps also are fitted. Crank and wrist pins and slides are supplied from a large brass tank with needle valves, sight feeds and tubes. Valves are so arranged that the feed being once set they can be closed and opened without further adjusting.

Following are some of the principal dimensions:

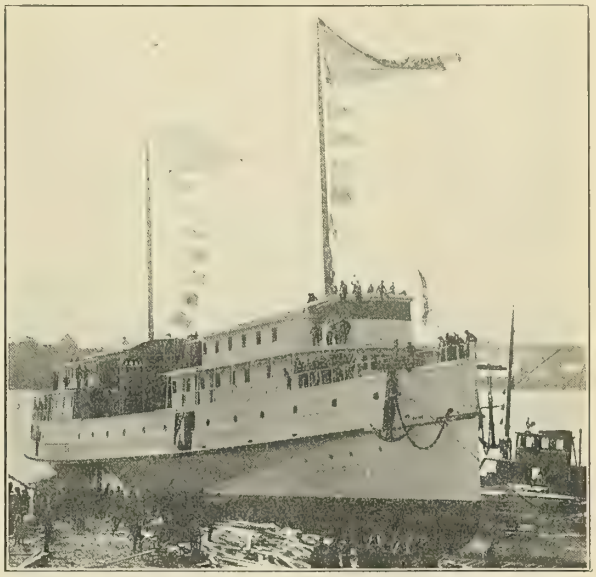
Length from face of coupling to forward end of crank shaft	71 in.
Length over cylinders	60 in.
Extreme width of bed plate	44 in.
From center of shaft to top of engine	79 in.
Diameter of main journals	4 in.
Diameter of crank pins	4 in.
Length of crank pins	6½ in.
Length of connecting rod, between centers	35 in.
Diameter of crosshead pin	2½ in.
Length of crosshead pin	4½ in.
Weight of engine	5,500 lbs.



COMBINED RATCHET WRENCH AND DRILL.

Ratchet Wrench and Drill.

The accompanying illustration of the Universal ratchet wrench shows a most convenient and useful tool. The tool is a fairly well equipped tool chest in itself and enables one to get at bolts, nuts, set caps and lag screws with extraordinary ease and dispatch. For overhead work and inclosed places it is particularly adapted, as it only requires a play of one inch to effectually operate. It is reversible and can be adjusted with great ease to take nuts of any size up to two inches diameter. All parts are made of material best suited to meet the severe requirements, and the wearing parts are hardened. It is light in weight, highly finished, and all parts are interchangeable. When it is desired to be used as a drill the drill and feed screw are attached, as shown, forming a very compact tool. This wrench is made by the Universal Manufacturing Company, 22 China street, Cleveland, Ohio.



LAUNCH OF THE RANSOM B. FULLER.

LAUNCHES.

Steamer City of Haverhill.—There was recently launched from the Atlantic Works, East Boston, Mass., the wooden steamer *City of Haverhill* for service between Boston and Haverhill, to carry both passengers and freight. The hull is 135 feet long, 25 feet broad and 8 feet deep, and was designed by Wm. T. and Richard Keough, of Boston. The vessel is to be driven by one set of compound engines with cylinders 12 and 28 inches in diameter by 20 inches stroke. Two water-tube boilers with 54 square feet of grate surface supply steam at 200 pounds pressure. The builders are Burtison and Paterson.

Tug John G. Chandler.—The tug *John G. Chandler,* built for the Commercial Tow Boat Company, of Boston, was launched from the yard of Kelley, Spear and Company, Bath, Me., on April 28. The vessel measures 102 feet in length, 20 feet in width and 11 feet 4 inches in depth, and is propelled by a compound engine. The tug will cost about $40,000, and was designed by Messrs. William and Richard Keough, of East Boston, Mass. The machinery, built by the Bath Iron Works, consists of a compound engine with cylinders 15 and 34 inches in diameter and 24 inches stroke, and a return tubular boiler.

Steamboat R. B. Fuller.—There was recently launched for the Eastern Steamship Company the steamer *Ransom B. Fuller,* built by the New England Shipbuilding Company, Bath, Me. As will be seen from the illustration, the *Fuller* is a side-wheel vessel built of wood. She is of the following dimensions: Length over all, 294 feet; beam, 40 feet; depth, 14 feet; draft, 8½ feet. The machinery consists of a low-pressure beam engine, with cylinder 63 inches diameter and 11 feet stroke, supplied with steam at 52 pounds pressure by two boilers. The paddle wheels are 27 feet in diameter and 10 feet face, and are fitted with feathering buckets which are 4 feet in width. The vessel was designed by Mr. Fred W. Rideout.

Yacht Chanticleer.—The schooner yacht *Chanticleer* was launched on April 10 at Morris Heights, New York city. It measures 118 feet over all, 70 feet on the water line, 22 feet beam, and 12 feet 6 inches depth, and will be owned by Mr. Geo. W. Wells, of Boston.

Steamer Tremont.—On May 7 the Maryland Steel Company launched from its marine works at Sparrows Point, Md., the steamship *Tremont* for the Boston Steamship Company. This vessel is a sister ship to the *Shawmut,* which was launched last winter, and which was described in Marine Engineering of January, 1902.

Steamship Nebraskan.—The steamship *Nebraskan,* for service in the American-Hawaiian Steamship Company, was launched from the yards of the New York Shipbuilding Company on May 19. The ship is 271 feet long, 46 feet beam, with a depth to the shelter deck of 34 feet 8 inches, and her boilers are equipped with oil burners.

Yacht Majorie.—The schooner yacht *Majorie,* built by Robert Jacob, City Island, N. Y., from designs by H. C. Wintringham, for Frank L. St. John, was successfully launched from City Island on April 5. The *Majorie* is a schooner yacht and her dimensions are: 89 feet over all, 62 feet on the water line, 18 feet beam, and 8 feet depth.

Steamer Ventura.—The freight and live-stock carrying steamer *Ventura,* built at the Victoria Machinery Depot, Victoria, B. C., for N. P. Shore and Company, of that city, was launched on May 5. The vessel is 160 feet long, 38 feet beam, and 11 feet deep, and is intended for the Skagway and Yukon River trade, and will be propelled by twin screws.

Destroyer Stewart.—On May 10 the U. S. torpedo boat destroyer *Stewart* was launched from the yard of the Gas Engine and Power Company and Chas. L. Seabury and Company, Consolidated, Morris Heights, New York. The length of the vessel along the load water line is 254 feet; beam, 23 feet; and the displacement, about 420 tons. Preliminary trials will be started in about two months, and it is expected that the vessel will probably be ready for commission in October.

Steamer Hermosa.—Wm. Miller recently launched from his shipyard at Mormon Island, near San Pedro, Cal., the passenger steamer *Hermosa,* which is of the following dimensions: Length over all, 150 feet; breadth, 28 feet; depth, molded, 13 feet 10 inches. The boat is owned by the Wilmington Transportation Company and is driven by one set of triple expansion engines. The furnaces of the boilers are equipped with oil burners.

Steamship James Gayley.—The freight steamship *James Gayley* was launched from the American Shipbuilding Company's yard at Cleveland, Ohio, on March 29. The vessel is 436 feet over all, 420 feet keel, 50 feet beam, 28 feet deep. Steam will be furnished by two Scotch boilers 13 feet 7 inches in diameter and 11 feet 6 inches long, to be allowed 170 pounds pressure and fitted with the Ellis and Eaves system of induced draft. The engine will be triple expansion with cylinders 22, 35 and 58 inches in diameter by 40 inches stroke. The vessel is building for the Cleveland Steamship Company.

Steamer Chas. Beatty.—The Craig Shipbuilding Company, Toledo, Ohio, recently completed the steamer *Chas. Beatty,* built for the lumber trade between Mackinac and Tonawanda. The vessel is 225 feet long, 40 feet beam, 16 feet deep and has a capacity of about one million feet of lumber.

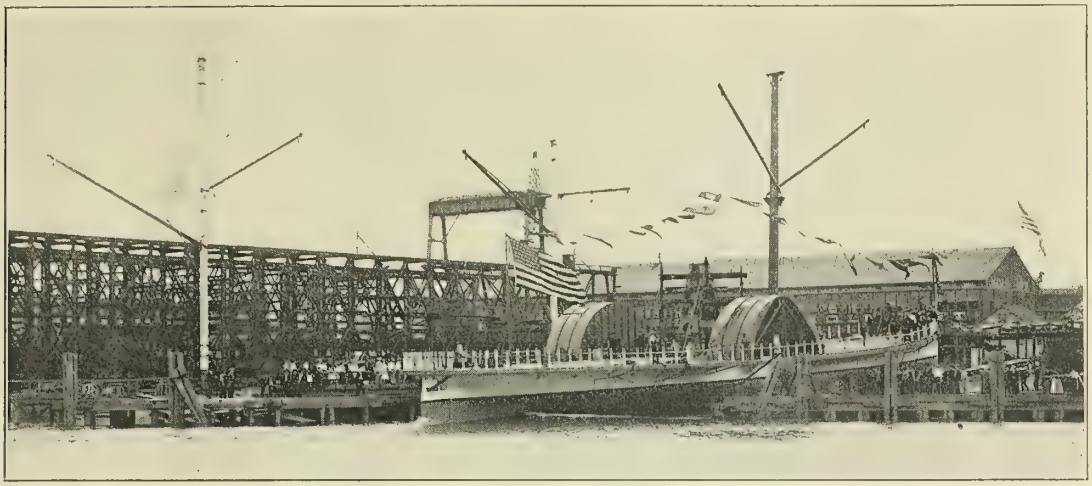
Tug John A. Hughes.—On May 14 the tug *John A. Hughes* was launched from John A. Dialogue and Son's shipyard, Kaighn's Point, Camden, N. J. The vessel was built to the order of Albert and James Hughes, of Philadelphia, and is 100 feet long, 20 1-2 feet beam, and 12 feet 3 inches deep. She is provided with wrecking pumps besides the usual instalment of auxiliaries.

J. M. Jenks.—The third vessel of the steamers built for Messrs. Howgood and Company, of Cleveland, the *J. M. Jenks,* was launched on May 16 in the Lorain yards of the American Shipbuilding Co. The vessel is 434 feet over all, 50 feet beam and 28 feet deep. She will have triple-expansion engines with cylinders 22, 35, and 58 inches in diameter by 40 inches stroke. There are two Scotch boilers fitted with Ellis and Eaves induced draft.

Pilot Boat New Jersey.—A handsome pilot boat for the New York and New Jersey Sandy Hook Pilots' Association was launched from the yards of A. C. Brown and Sons, Tottenville, Staten Island, on March 28, and christened the *New Jersey.* The vessel is of oak, 155 feet long, 29 feet beam, 18 feet deep, and will be supplied with triple-expansion engines of 650 horse power. The vessel will be comfortably fitted out for the accommodation of the pilots, and she will cost about $90,000.

Tug Sea Rover.—From the Fulton Engineering Works at Harbor View, San Francisco, Cal., there was launched on March 8 the steel tug *Sea Rover,* built to the order of the Ship Owners' and Merchants' Towboat Company. Her length over all is 128 feet; perpendicular length, 120 feet; beam, molded, 24 feet 6 inches; and depth, molded, 15 feet. The machinery consists of a compound engine with cylinders 17 and 41 inches in diameter by 28 inches stroke, and the boiler is 10 feet 6 inches in diameter, 16 feet 10 inches long, and is to burn oil fuel. The fuel tanks have a capacity of 50,000 gallons of oil.

Steam Yacht Aztec.—One of the largest pleasure vessels ever built in America, the steam yacht *Aztec,* was launched from the Crescent Shipyard, Elizabethport, N. J., on April 22. The *Aztec* was built from designs and under the supervision of Messrs. Gardner and Cox, and is owned by Mr. A. C. Burage, of Boston. The general dimensions are: Length over all, 250 feet; on water line, 215 feet; breadth, 30 feet; depth, 22 feet 6 inches; draft 13 feet 3 inches. She is built entirely of steel with transverse water-tight bulkheads and double bottom. The vessel was designed for deep sea cruising and has a steaming radius of 6,000 miles at a speed of 12 knots. There are two 4-cylinder triple expansion engines with cylinders 18, 25, 33 and 33 inches in diameter by 34 inches stroke, and at 200 revolutions are designed to indicate 2,500 horse power. Two Scotch boilers, built by the Cleveland Shipbuilding Company, furnish steam at 200 pounds pressure. The speed of the *Aztec* is expected to be 14 knots under natural and 16 knots under forced draft.



LAUNCHING THE MARYLAND AT WILMINGTON, DEL.

Yacht Celt.—The steam yacht *Celt,* designed by Mr. H. C. Wintringham for Mr. J. Rogers Maxwell, New York, was launched on April 12 from the yard of the Pusey and Jones Company, Wilmington, Del. The *Celt* is 170 feet long over all, 138 feet 6 inches on the water line, 23 feet 6 inches beam and 12 feet 6 inches in depth.

Steam Yacht Margaret.—On April 8 the steam yacht *Margaret* was successfully launched from the yard of the Gas Engine and Power Company and Chas. L. Seabury and Company, Consolidated, Morris Heights, New York city. The yacht is built for John H. Rutherford, of New York, for service on Lake Champlain and the Great Lakes, and the peculiar feature of the boat is that the bow and stern are detachable, so that the over all length may be diminished from 120 to 98 feet, in order that the vessel may pass through the canal.

Steam Yacht Jule.—On May 7 the steam yacht *Jule* was launched from Morris Heights yard, New York city. The vessel is built for Mr. Alfred Costello, of this city, and is for service on the St. Lawrence. The general dimensions are: Length over all, 85 feet; length on water line, 75 feet; beam, 12 feet 6 inches; draft, 4 feet 6 inches. The engine is the Seabury triple expansion of the latest type, with cylinders 7, 11 1-4, and 17 inches in diameter by 10 inches stroke. Seabury boilers supply steam.

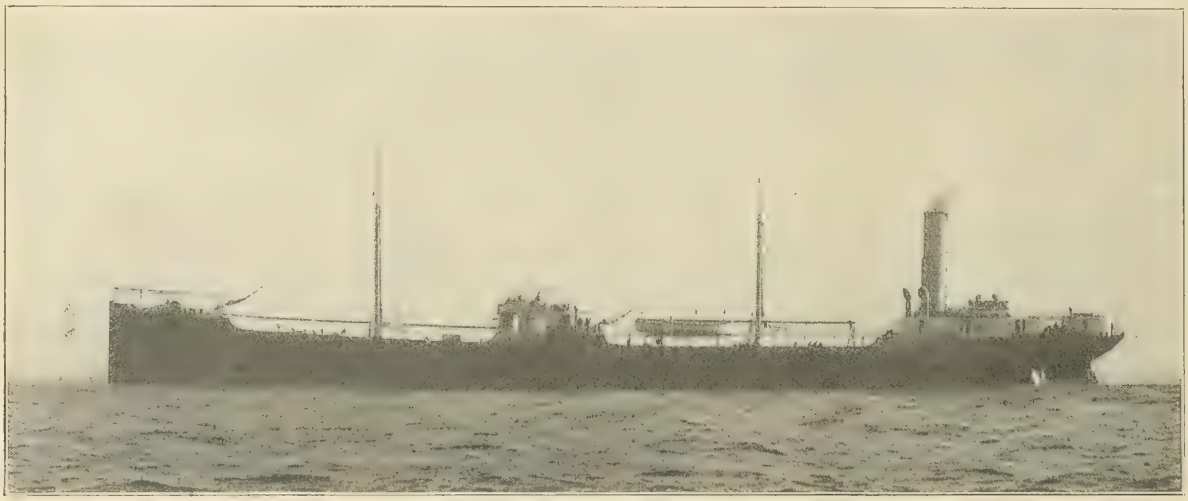
Russian Training Ship.—There was recently added to the Russian Navy the training ship *Okean,* of about 12,000 tons, 18 knots speed, which was built by the Howald Works at Kiel. The principal dimensions are: Length over all, 470 feet; beam, 58 feet; draft, 25½ feet. The *Okean* is the first war vessel which has been designed to serve the double purpose of transport and training ship. In the first-named capacity she will be used on the Pacific coast, and as a training ship will be used mainly for the instruction of engineers and stokers. Her crew consists of 25 officers and engineer instructors and 700 men. Her engines indicate about 11,000 horse power, and for purposes of instruction not less than four types of water-tube boilers have been installed, namely, six Bellville, six Niclausse, one Yarrow, and one Thornycroft.

Steam Yacht Pantooset.—On March 10 the steam yacht *Pantooset* was launched from the yards of the Bath Iron Works, Bath, Me., built to the order of Commodore A. S. Bigelow, Boston. The yacht is 212 feet 6 inches over all, 27 feet 2 inches beam, 16 feet 6 inches deep.

Steam Yacht Vixon.—The new yacht *Vixon,* built at Morris Heights, New York, for John D. Archibald, was launched on April 23. The dimensions of the boat are 100 feet over all, 12 feet beam and 5 feet draft. The yacht is designed to make high speed and is propelled by two sets of triple expansion Seabury engines furnished with steam at 250 pounds pressure by a Seabury water-tube boiler.

Steam Yacht Hauoli.—On May 31 there was launched from J. N. Robbins' yard, Erie Basin, Brooklyn, the steel steam yacht *Hauoli,* owned by Mr. F. M. Smith, of San Francisco, and designed by Mr. Henry J. Gielow, of New York. The principal dimensions of this vessel are: Length over all, 153 feet 7 inches; on water line, 122 feet 9 inches; beam, extreme, 17 feet 6 inches; depth, 9 feet 8 inches. There are two mahogany deck houses, the forward one containing the dining saloon and the after one the social hall. The engine is of the four-cylinder, triple-expansion type, and steam is supplied by two water-tube boilers of 250 pounds pressure. Under natural draft it is estimated that the vessel will steam at 17 1-2 miles.

Steamboat Maryland.—The side-wheel steamboat *Maryland,* building for the Baltimore, Chesapeake and Atlantic Railway Company at the yard of the Harlan and Hollingsworth Company, Wilmington, Del., was launched on May 24. The vessel is to ply on the Chesapeake Bay and tributaries, and is fitted for service of night boat, with passenger sleeping accommodations for 200. The vessel is 180 feet long between perpendiculars; 34 feet beam, molded; 55 feet 6 inches over guards; 10 feet 1 inch molded depth. Her motive power consists of a vertical surface condensing beam engine with cylinder 38 inches in diameter by 9 feet stroke, and with Stevens cut-off proportioned for 60 pounds pressure. Her speed is to be 15 miles per hour.



BRITISH TANK STEAMER KINSMAN, RECENTLY LAUNCHED.

Auxiliary Yacht Ariadne.—The steel, schooner-rigged, auxiliary steam yacht building for Mr. Henry W. Putnam, Jr., New York city, from designs furnished by Messrs. Tams, Lemoine and Crane, was launched at the yards of Harlan and Hollingsworth Company, Wilmington, Del., on May 22, and christened the *Ariadne*. The dimensions of the yacht are: Length on deck, about 131 feet; length on load water line, 110 feet; extreme beam, 26 feet; depth amidships on center line, 19 feet; draft, aft, 14 feet. The motive power consists of a 2-cylinder compound engine, supplied with steam from two Almy watertube boilers at 250 pounds pressure.

Torpedo Boat Hopkins.—On April 24 the Harlan and Hollingsworth Company, of Wilmington, Del., launched the torpedo boat destroyer *Hopkins*, known as Number 6. The *Hopkins* is a sister boat to the *Hull*, building by the same company, and is of the following dimensions: Length, 245 feet; extreme breadth, 23 feet; draft, 6 feet 6 inches; corresponding displacement, 408 tons. Four Thornycroft water tube boilers will furnish steam at 300 pounds pressure to the twin screw, vertical, four-cylinder, triple expansion engines with cylinders 20 1-2, 32, 38 and 38 inches in diameter by 22 inches stroke, designed to indicate about 8,000 horse power. The guaranteed speed is 29 knots.

Hamburg-American Liner Moltke.—The most recent addition to the Hamburg-American line is the steamship *Moltke* which arrived in New York March 20. The *Moltke* is a sister ship to the *Blücher* and is of the intermediate type of passenger and freight steamer. The vessels are 525 feet long, 62 feet wide, 45 feet deep and are equipped with two sets of quadruple expansion engines developing 8,000 horse power and giving a speed of 16 knots. The accommodations for the first-class passengers are located on five decks amidships. On the boat deck is a gymnasium and grill room, on the promenade are drawing room, smoking room and many fine staterooms. On the saloon deck is the dining saloon, with a seating capacity of 225, and many more fine cabins. The upper and main decks are devoted entirely to staterooms.

Turbine Yacht.—A very fast yacht, built to the order of Colonel McCalmont from designs prepared by Messrs. Cox and King, was launched on May 24 from the yard of Messrs. Yarrow and Company, Poplar. This yacht is of very special design, being built on the lines customary with vessels of the torpedo-boat class and provided with turbine engines constructed by Messrs. Parsons, fitted with three shafts and three propellers on each shaft. As regards the hull and boilers, the yacht is identically similar to a first-class torpedo boat, the boilers being of the Yarrow type; therefore the trials will be watched with interest, as forming a fair comparison with those of similar vessels provided with boilers of this class but fitted with reciprocating engines, the machinery being the only portion of the vessel in which it differs from a Yarrow first-class torpedo boat.

Petroleum Steamer Kinsman.—The latest addition to the large fleet of oil-carrying steamers built at the Walker shipyard of Messrs. Armstrong, Whitworth and Company, Limited, is the *Kinsman*, which was launched last October and is here illustrated. The vessel has been built to the order of the Bear Creek Oil and Shipping Co., Ltd., Liverpool, and is of the following principal dimensions: Length, 373 feet; breadth, 49 feet 9 inches; depth molded to upper deck, 30 feet 3 inches. She is capable of carrying 6,500 tons on a moderate draft of water. The vessel has a poop, bridge, and topgallant forecastle, and is rigged as a two-masted fore-and-aft schooner. The accommodation for the captain and officers is in the bridge, for the engineers in the after end of the poop, and the seamen and firemen will be berthed in the forecastle. The vessel is built of steel under special survey for Lloyd's highest classifications. The vessel has large cargo hatches to enable her to carry general cargo, should it be so desired. Complete pumping and piping installations for dealing with the liquid cargo have been fitted, and electric light supplied throughout the ship. The *Kinsman* is fitted with triple-expansion machinery manufactured by the Wallsend Slipway and Engineering Company, Limited.

TECHNICAL PUBLICATIONS.

The Balancing of Engines, by W. E. Dalby. Size 5½ by 9. Pages 283, with 173 diagrams in the text. Price $3.75. Longmans, Green & Co., London and New York.

This book appears at an opportune time, when the balancing of engines, both locomotive and marine as well as stationary, is attracting an increasing amount of attention. During the last ten years this subject has forced itself strongly upon the attention of marine engineers, and at the present time in all careful designs, and especially where high speed conditions are involved, the question of engine balance is one which must receive due attention. The purpose of this book seems to be the development of a semi-graphical method which may be used for the investigation of the various problems which arise in connection with the balancing of engines of any and all types. From the nature of the problem and of the method proposed, the writer finds it necessary to begin the discussion of the subject with a chapter on "Vector Quantities" and their addition and subtraction. Following this he discusses in chapter ii. the balancing of revolving masses, and in chapter iii. the balancing of reciprocating masses, when the effect due to the angularity of the connecting rod is considered unimportant. This is followed in chapter iv. with a general discussion of the balancing of locomotives, with illustrations from English and American practice. In chapter v. the author discusses the influence due to the angularity of the connecting rod, and shows the amount of error involved in omitting forces beyond those of the second order. Both analytical and graphical methods are given for the determination of the acceleration involving the angularity of the connecting rod, and illustrations are given of the application of the method to engines having one, two, three, four, five, and six cranks. In chapter vi. the same subject is extended by the introduction of additional practical methods and by discussion of the influence due to valve gear and suitable methods for its determination. In chapter vii. the subject of vibration is discussed in a simple manner, especially as manifested under the influence of such forces as are developed by an unbalanced marine engine. The last chapter is devoted to a general discussion of the connectinng-rod problem, the purpose of the discussion being a more detailed examination of the forces due to the connecting rod which act at its upper and lower ends. The character of these forces is discussed, and the equations developed are illustrated by diagrams and other illustrative matter.

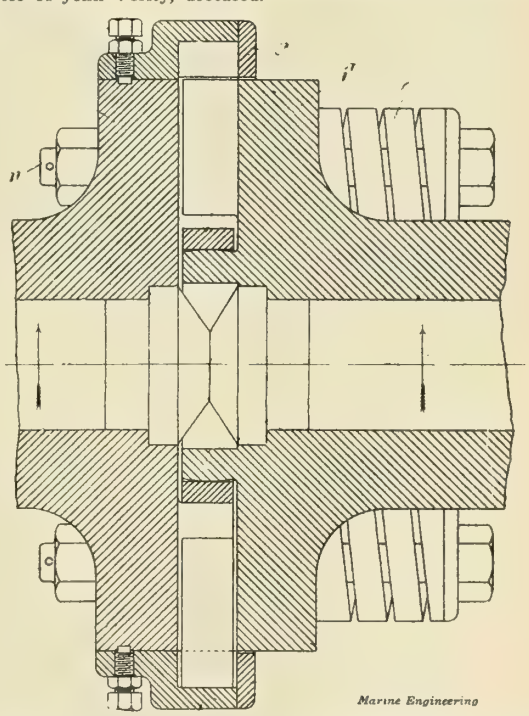
Taken as a whole, this book forms a most acceptable and valuable contribution to the literature of this subject. It is an interesting commentary on the increasing importance of this topic that a few years ago the entire literature consisted of a few papers scattered here and there in the transactions of engineering societies, while at the present time its importance is such as to justify the author in the preparation of a book entirely devoted to this subject. Outside of the intrinsic value of the book itself, which is great, one of its most valuable features lies in the fact that it gathers together in one publication the leading features of the entire problem, and gives methods suitable for its investigation, thus saving the student from the expenditure of the large amount of time and energy needed to examine th various original papers for himself. To all marine engineers and designers who are concerned with the problem of the balancing of engines we would cordially commend this work as providing a sufficiently complete discussion of the subject for all practical purposes, together with such practical methods of investigation and determination as have proved themselves valuable in actual experience with such problems.

Beeson's Marine Directory, 1902. Harvey C. Beeson, 360 Dearborn street, Chicago, Ill. One vol., 258 pp., 6½ by 9½ in. Price, $5.

The fifteenth annual edition of the Beeson's Marine Directory of the Northwest Lakes for 1902 has just been issued. Among the leading features are lists of steam and sailing vessels on the Lakes; the names of the owners of the Lake vessels; the records of engines and boilers on Lake vessels; lists of Canadian vessels on inland waters; vessels whose names have been changed; records of marine disasters; ore docks; classified trade directory of firms and companies connected with Lake maritime industries. The distinctive feature of this year's book is the list of iron ore carriers, with cargo capacity of each on a given draft, and also about twenty pages devoted to important decisions in Admiralty cases that should be of interest to Lake navigators. Many articles appear on subjects of general maritime interest, and the volume is well illustrated with many views of vessels of all classes. It is well printed on heavy paper and strongly bound in cloth.

SELECTED MARINE PATENTS.

699,356. COUPLING FOR SHIPS' PROPELLER SHAFTS. WILLIAM W. WHITE, NEW YORK, N. Y., ancillary executor of John Verity, deceased.

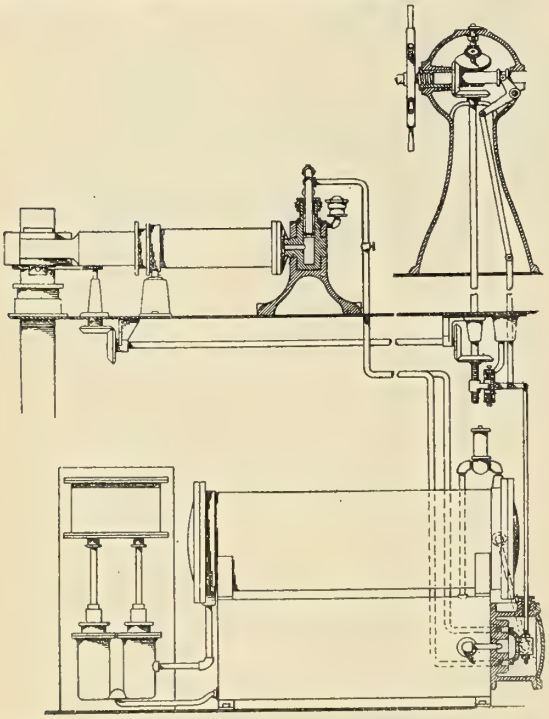


CLAIM.—1. In a ship's propeller-shaft comprising a plurality of lengths, a length of shafting having a coupling-flange x at each end, and between these ends a flexible device consisting of a flange i on one part of the shaft with projections j on its inner face, a flange i' on the other part having projections j on its inner

face, adapted to fit in the spaces between the projections j of the other flange, oppositely-disposed bearing-heads z, with shoulders z' fitting in and supported in the ends of said shaft, and inwardly-tapering bearing-faces; keys p fitting between two of the adjacent faces or edges of the projecting parts j, wedges q disposed between the other adjacent edges of said parts j, a wedge-holding cam-ring s fitting over the flanges ii', having cam-recesses t in which the ends of the wedges q work, a projecting annular flange or ring k on the flange i, and a ring r fitting outside and on the ring k, and supporting the inner ends of the keys p, and a plurality of bolts n and springs o, said bolts passing through said flanges i and parts j. Three claims.

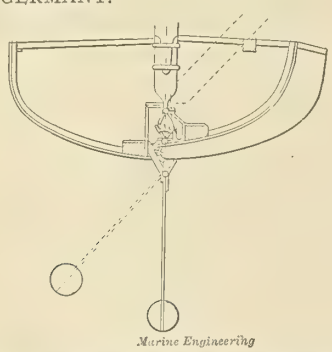
699,450. DEVICE FOR CORRECTING COMPASS ERRORS. JORGEN CHRISTENSEN, SAN FRANCISCO, CAL. Five claims.

699,451. HYDRAULIC STEERING MECHANISM. JORGEN CHRISTENSEN, SAN FRANCISCO, CAL.



CLAIM.—1. The combination in a steering mechanism of oscillating hydraulic cylinders, having connection through their pivot ends with a source of fluid-supply, and means connecting the cylinders whereby the fluid may flow from one cylinder to the other, pistons reciprocable within said cylinders, piston-rods connected with the stock of the rudder, means for controlling the flow to and from said cylinders whereby the pistons are actuated to move the rudder, and means upon the rudder-stock whereby said flow may be automatically checked when the rudder has swung a certain distance in either direction. Sixteen claims.

700,011. BOAT OR VESSEL. JULIUS F. BECKER, HAMBURG, GERMANY.



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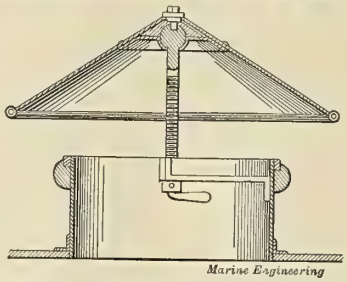
CLAIM.—In a ship, boat, or other vessel, the combination of a hinged mast, a toothed segment rigidly secured to said mast below the hinge, a shaft, a second toothed segment secured on said shaft and meshing with the segment secured to the mast, a third toothed segment secured to said shaft, a lever carrying a weight, a fourth toothed segment, secured to said lever, substantially as, and for the purpose, set forth.

700,012. PROTECTIVE TUMBLING-HOOD FOR SHIPS' HATCHES. JOHN BERGESEN, NEW YORK, N. Y.

CLAIM.—1. The combination with an inwardly-projecting arm secured to the upper end of the article to be protected and provided with a nut at its free inner end, of a screw-threaded rod screwing into the nut of the arm and provided with a ball at its upper end, and a conical hood having a socket on its inner face at the apex to receive the ball of the rod, said hood



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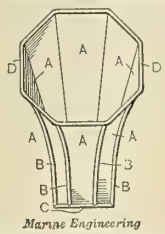
being of a diameter considerably greater than that of the article and adapted to be seated on the upper edge of same, as set forth. Two claims.

699,928. SHIP'S VENTILATOR. CHARLES McVEETY AND JOHN F. FORD, PHILADELPHIA, PA.



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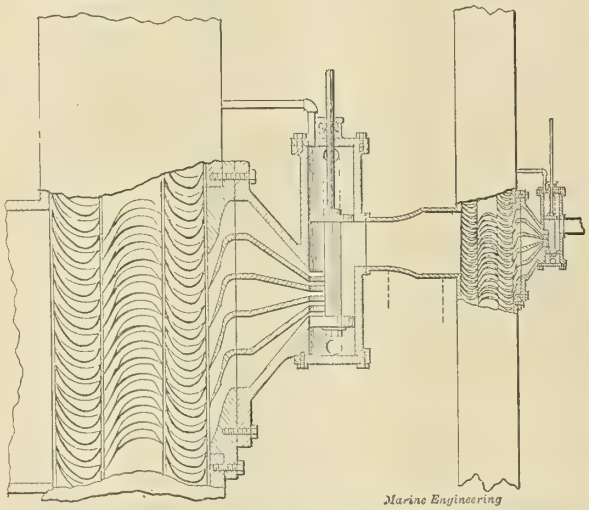
CLAIM.—2. A ventilator comprising a curved tapered pipe octagonal in cross section, composed of plates A, having upturned end forming grooves, ribs B in the form of split tubes for engaging and holding said plates in position, and ribs C and D arranged respectively at the base and mouth of the ventilator, having slotted openings to receive the plates and openings for the ribs, substantially as specified. Two claims.

700,278. REVERSIBLE SCREW-PROPELLER. LIDA WILSON, BROOKLYN, N. Y. Eight claims.

700,280. APPARATUS FOR UNLOADING VESSELS. CYRUS H. WOODRUFF, BUFFALO, N. Y. Three claims.

700,314. STEAM-TURBINE. JOHN H. FEDELER, NEW YORK, N. Y. Five claims.



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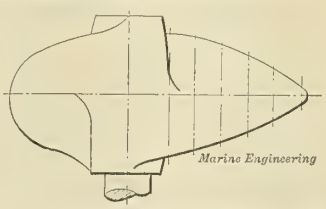
700,365. SCREW-PROPELLER. CHARLES A. PARSONS, NEWCASTLE-UPON-TYNE, ENGLAND.



Marine Engineering

CLAIM.—1. A screw-propeller provided with blades constructed with a reduced pitch toward their tips, the reduction commencing from about one-half to two-thirds outward from the blade-roots.

2. A screw-propeller having vanes secured to the propeller-cone behind the blades. Two claims.

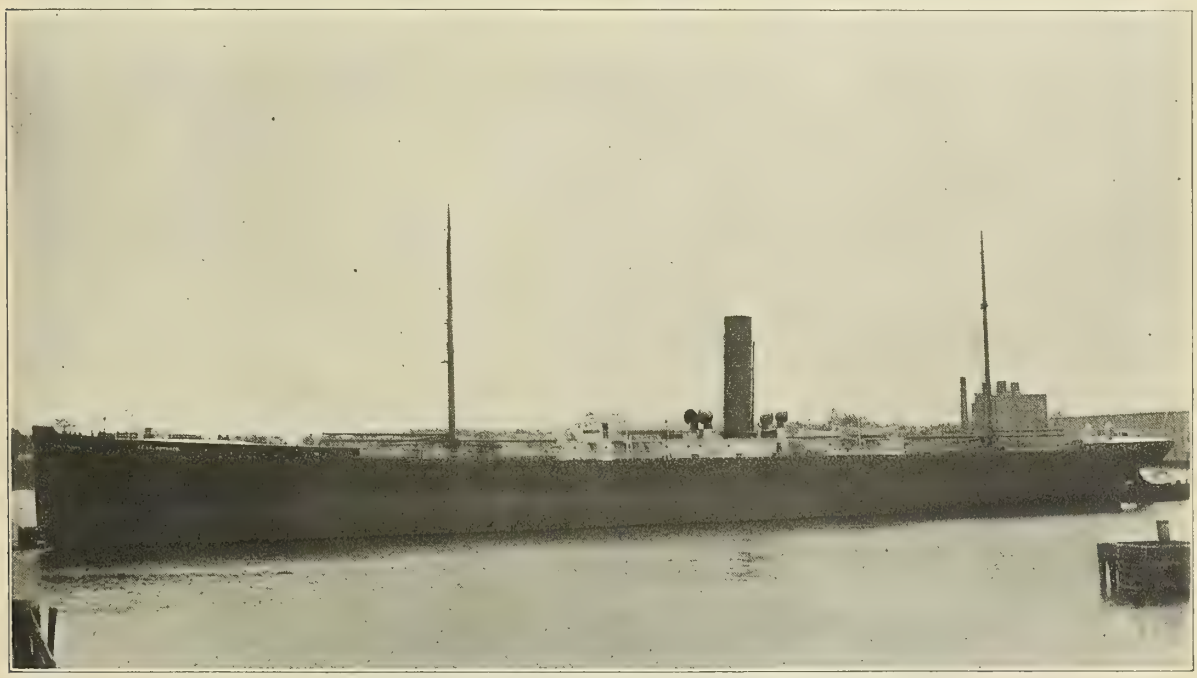
INDEXED.

Marine Engineering

Vol. 7. NEW YORK, AUGUST, 1902. No. 8.

THE RECONSTRUCTED SAALE.

Seldom, except in the dismantling of a ship to become a coal barge, is there found such a great change in a reconstructed vessel as that which has been carried out by the Townsend-Downey Shipbuilding Company, Shooter's Island, New York, on the steamer formerly known as the *Saale*. It will be recalled by readers of MARINE ENGINEERING that this vessel of the North German Lloyd Steamship Company was one of three which were very badly damaged by the Hoboken pier fire two years ago.



THE FREIGHT STEAMER J. L. LUCKENBACH, FORMERLY THE SAALE.

The vessel was bought by Mr. Lewis Luckenbach for about $80,000, and was later taken to the shipyard of the above-mentioned firm for general overhauling. Little is left in this new freight steamer, named the *J. L. Luckenbach*, to remind one of the former passenger steamer *Saale*. All of the cabin and bridge house have been removed, and all space below the main deck—which is the weather deck—except that necessary for the engines, boilers, and coal, is given up to cargo space.

The forecastle for crew and firemen is located at the forward end of the 'tween decks. Under the forecastle head are the quarters for the boatswain, carpenter, cooks, carpenter shop, lamp, paint and store rooms, and toilets. In the forward steel deck house, which is around the boiler-room casing, are the quarters for the deck officers, officers' mess room, pilot and steward's rooms. Then comes a large coal chute extending the width of the house, leading to the athwartship bunker below. Aft of this are spare state rooms, the forward fidley grating, the galley, uptake, store room, and large fidley grating. At the forward end of the engine room deck house are state rooms for the chief engineer and his two assistants. The steering engine is located under the poop, and a new line of shafting leads to the pilot house.

With the exception of a small 10 by 10-foot hatch leading to No. 1 hold, all hatches are new. There are two hatches leading through all decks, 16 by 25 feet; one located forward and the other aft of the foremast, which is of steel and has four booms 42 feet long. At No. 2 hatch there is one cargo winch and at No. 3 hatch there are two winches. Between the engine and boiler rooms is a 16 by 12 foot hatch leading to the after 'thwartship coal bunker in the hold and to the cargo 'tween decks. The steel mainmast is stepped between the two main after hatches, which are 16 by 25 feet, and each hatch is served by two booms, the forward one by two winches and the after one by one winch.

As seen in the engraving, there is an open rail for-

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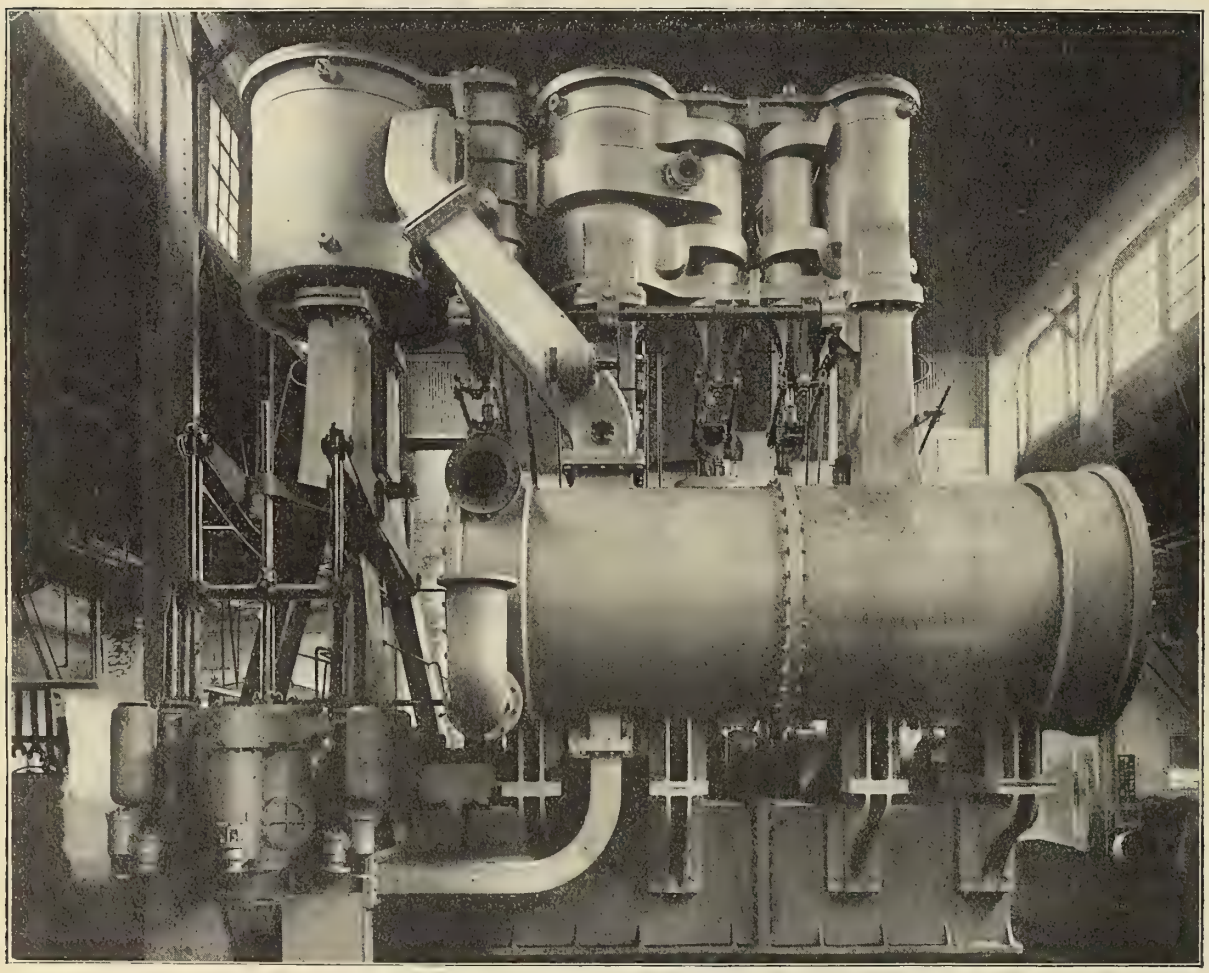
ward and aft, which greatly improves the general appearance of the ship. The pilot house and chart room are on the bridge deck. There are four lifeboats on this deck, and on either side of the bridge is a steel lighthouse. These lighthouses were formerly located at the break of the forecastle.

The general dimensions of the vessel are as follows: Length between perpendiculars, 438 feet; beam, 47 feet 10 inches; depth of hold, 34 feet 8 1-2 inches; draft, loaded, 28 feet aft, 26 feet forward. The ship has a bar keel, angle framing, and T bulb beams with forged knees. She has four complete steel decks forward and aft 'thwartship bunkers and in the wing bunkers is about 900 tons.

Fire lines are laid on the main deck, and steam pipes are led to each and every hold, to be used in case of fire.

Entirely new triple-expansion engines have been built by the Townsend-Downey Company, and the front and back views are shown in the accompanying engravings taken of the engines while standing on the erecting floor of the machine ship. The diameters of the cylinders are as follows: H. P., 26 inches; M. P., 44 inches; L. P., 70 inches, and the common stroke is 48 inches.



REAR VIEW OF THE TRIPLE-EXPANSION ENGINES FOR THE STEAMER J. L. LUCKENBACH.

and aft. In the course of repairing the vessel all the plating was faired up and the steel throughout was carefully scraped and painted. One-third of the main and 'tween decks is new and about fifty new steel plates had to be fitted on the sides. New bulkheads have been erected as follows: Between the second and third hatches up to the lower deck; at the after end of No. 3 hold to 'tween decks; the donkey-boiler recess was also moved aft 20 feet, and a new bulkhead erected between Nos. 4 and 5 holds up to the lower deck.

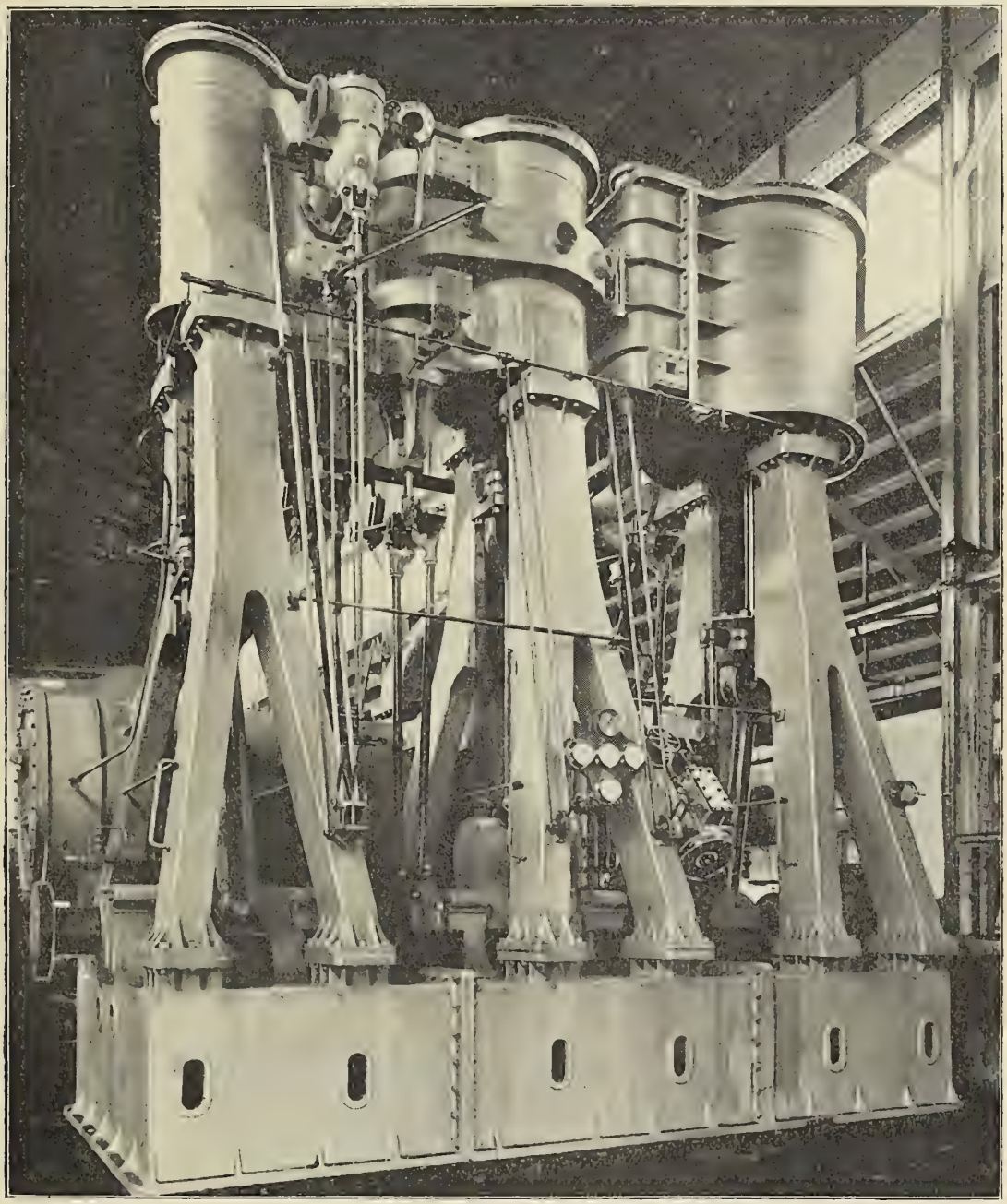
The *Saale* was equipped with four double-end Scotch boilers, but in the present ship the two forward ones have been removed. The coal capacity in the forward

The high and intermediate valves are of the piston type and placed between their respective cylinders. A double-ported slide valve is on the forward side of the low-pressure cylinder. The engine bed is a cast-iron box girder, and the cylinders are mounted on double Y cast-iron columns. The crank shaft is 13 5-8 inches diameter, of solid forged steel. The valve gear is of the Stevenson double eccentric type, operated by a steam cylinder which is seen on the front of the engine. The air and bilge pumps are driven by levers from the low-pressure crosshead, and a condenser, which is a separate casting, is bolted to the bed plate of the engine, as shown in the view on this page. The condenser has about 3,500

square feet of cooling surface. The two main boilers are 14 feet 2 inches diameter by 18 feet long and carry a working pressure of 180 pounds. There are three Purves furnaces at each end of each boiler, with a total grate surface of 266.5 square feet. The heating surface of both boilers is 7,544 square feet. The auxiliary boiler is a horizontal, single-end multitubular, 11 feet 5 3-4 inches diameter by 10 feet 5 1-4 inches long, with two furnaces. These three boilers are the ones which were formerly in this ship.

An eight-hour trial was recently carried out at sea with the vessel light, when a speed of 13.6 knots an hour was made. The revolutions per minute were 75, the total I. H. P. 2,500.

The *J. L. Luckenbach* leaves the shipyard as a fine type of ocean freighter. No money has been spared in remodeling her for the service in which she will be placed, as about $160,000 have been spent in this work. The vessel is classed in the Register of the American Bureau of Shipping.



ENGINES FOR THE J. L. LUCKENBACH, BUILT BY THE TOWNSEND-DOWNEY SHIPBUILDING COMPANY.

The United States Navy.—There are at present building in private yards for the United States Navy fifty-eight vessels in all. Eight of these are battleships.

POWERING SHIPS.

BY HORACE HOLDEN THAYER, JR.

Engineering data are of value chiefly as a basis for the estimation of new work, and any system by which these data may be accurately classified, standardized, and put into shape for immediate use is of great value to the estimator. The ideal foundation for a speed-power data classification is the "Law of Comparison," as set forth in "Resistance and Propulsion of Ships," by Durand.

While the full explanation of the law is not within the scope of this paper, the two of its statements made use of here are:

(1) The ratio between the powers necessary to propel similar ships at corresponding speeds is equal to the ratio of the products of displacement and speed.

$$\frac{H_2}{H_1} = \frac{D_2 u_2}{D_1 u_1}$$

The ship, propeller, and machinery should be similar.

(2) The corresponding speeds are to each other as the sixth root of the displacement ratio.

$$\frac{u_2}{u_1} = \left(\frac{D_2}{D_1}\right)^{\frac{1}{6}}$$

So having the speed-power data for any ship—say the displacement, power, and speed—the power for a similar ship of known displacement at a corresponding speed may be readily ascertained.

If an estimate of power is required for a 5,000-ton ship and the data at hand for a similar ship are,

$$D_1 = 10{,}590 \text{ tons},$$
$$H_1 = 16{,}224 \text{ I.H.P.},$$
$$u_1 = 20.75 \text{ knots},$$

the corresponding speed,

$$u_2 = u_1 \left(\frac{D_2}{D_1}\right)^{\frac{1}{6}} = 18.32 \text{ knots},$$

and the required power,

$$H_2 = H_1 \left(\frac{D_2 u_2}{D_1 u_1}\right) = 6{,}770 \text{ I.H.P.}$$

In general the power will be required, not at a corresponding speed, but at some desired speed, so that several ships have to be used and a curve run through the points obtained, from which the power at the desired speed may be read. As it is often impossible to obtain data for several ships exactly similar to the one in hand, the question arises as to what factor in the similarity should govern the selection of the type ships.

This paper embodies the results of an investigation along this line and demonstrates the practical utility of the "Law of Comparison."

Taking, first, data from a number of ships of both Government and merchant types, and, without regard to the question of similarity, calculating from each the power required to drive a hypothetical 5,000-ton ship, we obtain spots for a speed-power curve as shown in Fig. 1. While a mean curve drawn through these points would admit of too wide a variation to have practical value, it nevertheless would possess the characteristics of a speed-power curve and in so far proves the applicability of the law.

As the question of the propulsive efficiency of the engine and propeller enters into the problem to some extent, a classification on the basis of similarity of the machinery might be deemed of value, but the results (Fig. 2) show no greater accuracy than with no consideration of the similarity at all. That such a classification is out of the question is clearly shown by taking two widely different types—one making 70 revolutions per minute and the other 125.

As the power absorbed in overcoming the various kinds of external resistance—head, frictional, wave-making, etc.—depends largely on the form of the ship, that is the consideration of most importance in estimating from the results of previous performances. In an attempt to eliminate this factor, only those ships are used which have a block coefficient of from .55 to .60 (Fig. 3), but the estimate might still be wide of

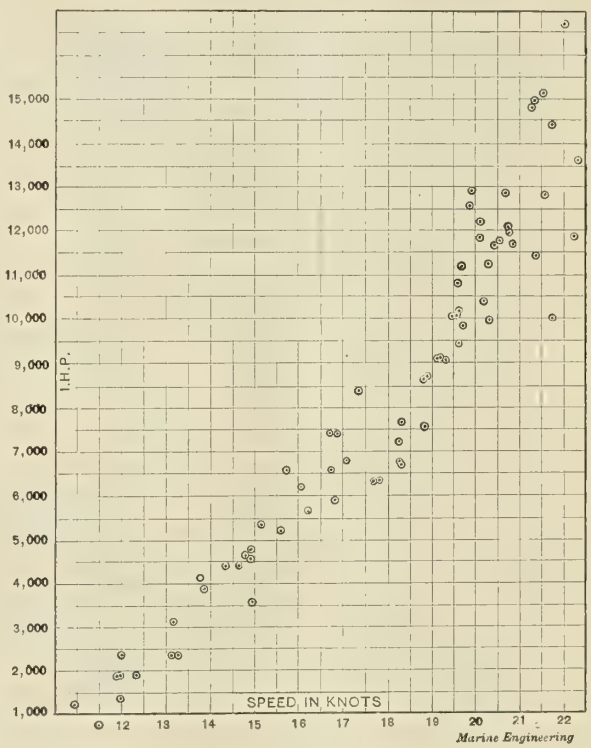


FIG. 1.

the mark. That the block coefficient cannot be used as a basis for classification is definitely shown from the fact that two vessels with a coefficient of .80 lie on the same speed-power curve as those just dealt with.

If we consider a ship's fore body as a wedge moving through the water, we note that a great factor in the resistance is the direct pressure of the water upon its two faces, and the greater the component of the surface perpendicular to the direction of motion the greater will be this resistance. With two ships of the same length and different beam, the more beamy vessel will have the greater component of surface perpendicular to the direction of motion, and we should therefore expect it to absorb more power in its propulsion at a given speed.

Comparing according to the proportion of length to breadth, and using all the data at hand for ships with

$\frac{L}{B}$ about 6.5, we obtain the definite series of points shown in Fig. 4, even though the type of ship has received no other consideration.

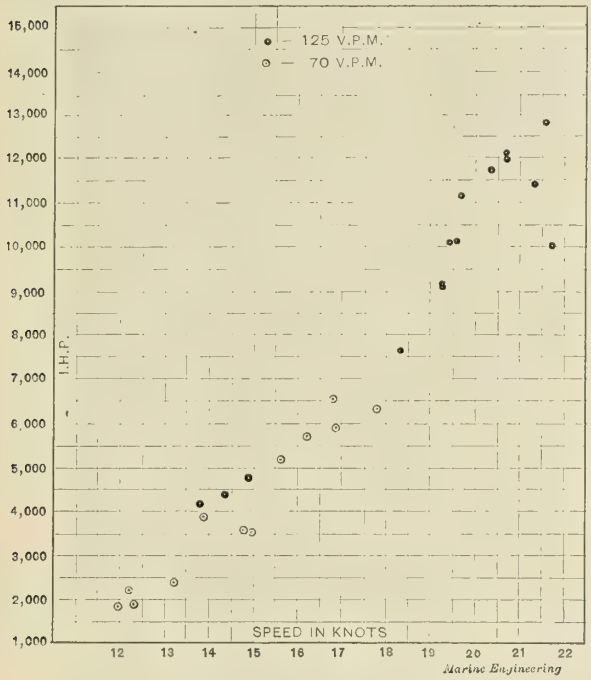


FIG. 2.

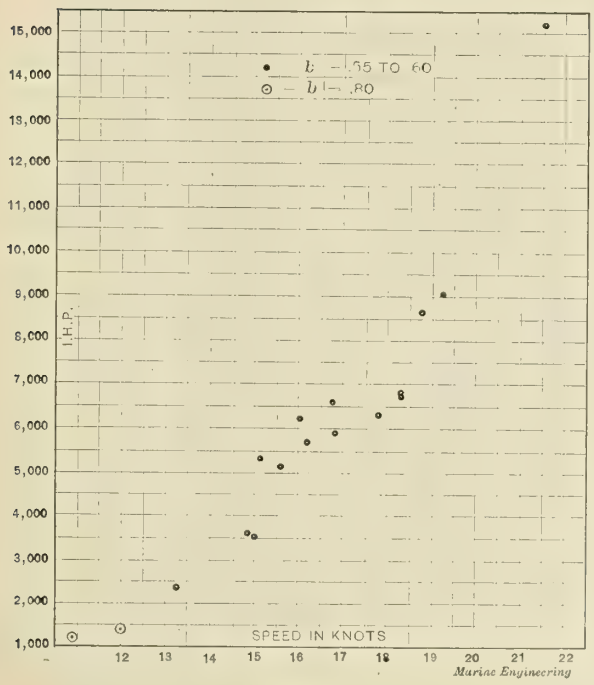


FIG. 3.

Both Government and merchant ships of various types are represented; the revolutions vary from 64 to 150 per minute and the block coefficient from .49 to .57. The lower series of points is for $\frac{L}{B}$ of about 8.7 and the upper series for a type of vessel with $\frac{L}{B}$ about 4.7.

Evidently there is here a basis for classification. The curves clearly indicate the superior economy of the long, narrow ship and the importance of the consideration of the beam factor in designing a ship which shall be easy to drive.

Having curves for various proportions of length to breadth for any one displacement, the power for a ship of any proportion at any speed and displacement may be obtained.

Given D_1, u_1, and $\frac{L}{B}$, the corresponding speed $u_2 =$

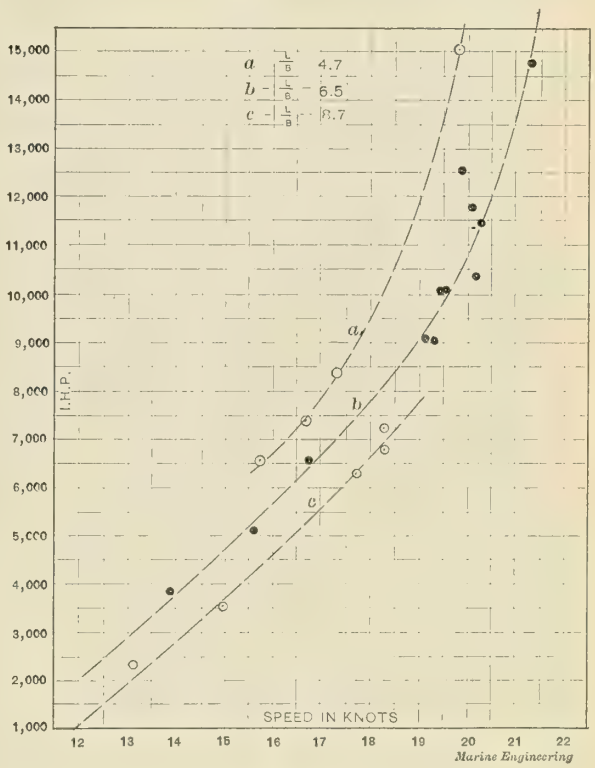


FIG. 4.

$$\left(\frac{D_2}{D_1}\right)^{\frac{1}{6}} u_1$$

and for this speed, u_2, the power of the type ship H_2 may be read from the curves. Then for this proportion of length to breadth,

$$H_1 = H_2 \left(\frac{D_1 u_1}{D_2 u_2}\right).$$

In order to obviate the necessity for calculating $\left(\frac{D_2}{D_1}\right)^{\frac{1}{6}}$ in each case, a curve of sixth roots may be plotted and the value read from it for the corresponding value of $\frac{D_2}{D_1}$.

Or suppose that there are at hand the particulars of a ship very similar to the proposed vessel. The power to propel a ship of the same displacement as

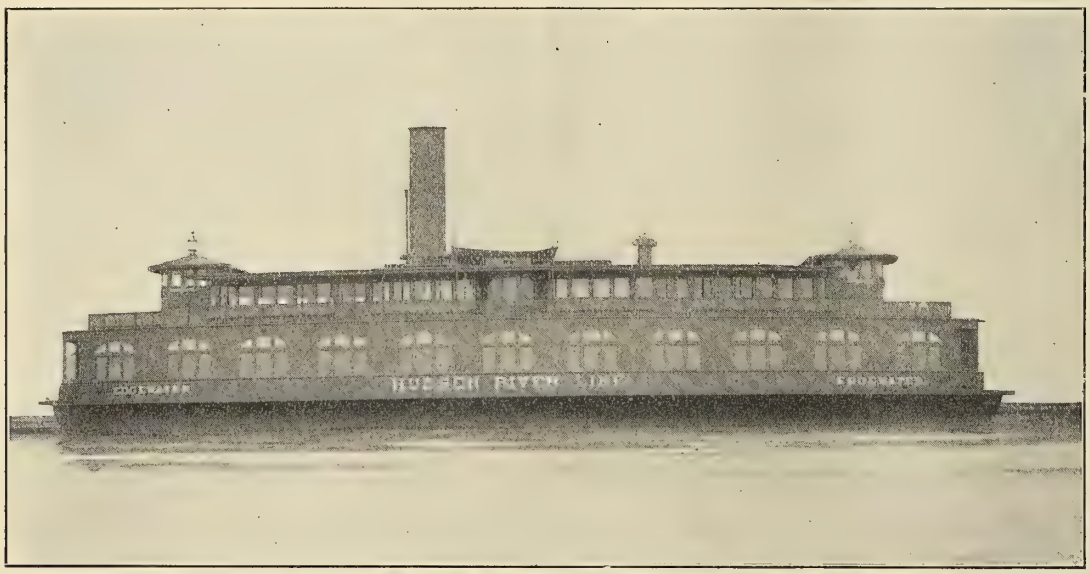
that of the curves at a corresponding speed may be derived from it, and through this point a line may be drawn parallel to the curve which shows the governing law for that proportion of $\frac{L}{B}$. Then from this curve the power of the new vessel at any speed may be derived.

From the results obtained by attention to the single feature of the proportion of length to breadth of a vessel in using her as the basis for an estimate, it can readily be seen that when the hull, machinery, and propeller of the type ship are similar to those of the proposed ship, the "Law of Comparison" gives very accurate results—much more so than any other method of estimation.

FERRYBOAT EDGEWATER.

The ferryboat *Edgewater*, here illustrated, has just been placed in service between 130th street and Edgewater, terminals of the New York and Hudson River Railway and Ferry Company. The vessel was built in Wilmington by the Harlan and Hollingsworth Company, and represents the finest type of boat for this service.

She is a double-deck steel ferryboat, with upper works somewhat similar in appearance to the Pennsylvania Railroad ferryboats, the lower cabins extending to the extreme ends. The length over all is 180 feet and the over-all beam 60 feet. The vessel is designed for speed, besides for service as an ice breaker for forcing her way through the large ice floats encountered in the upper part of the harbor.



FERRYBOAT EDGEWATER, BUILT BY THE HARLAN AND HOLLINGSWORTH COMPANY.

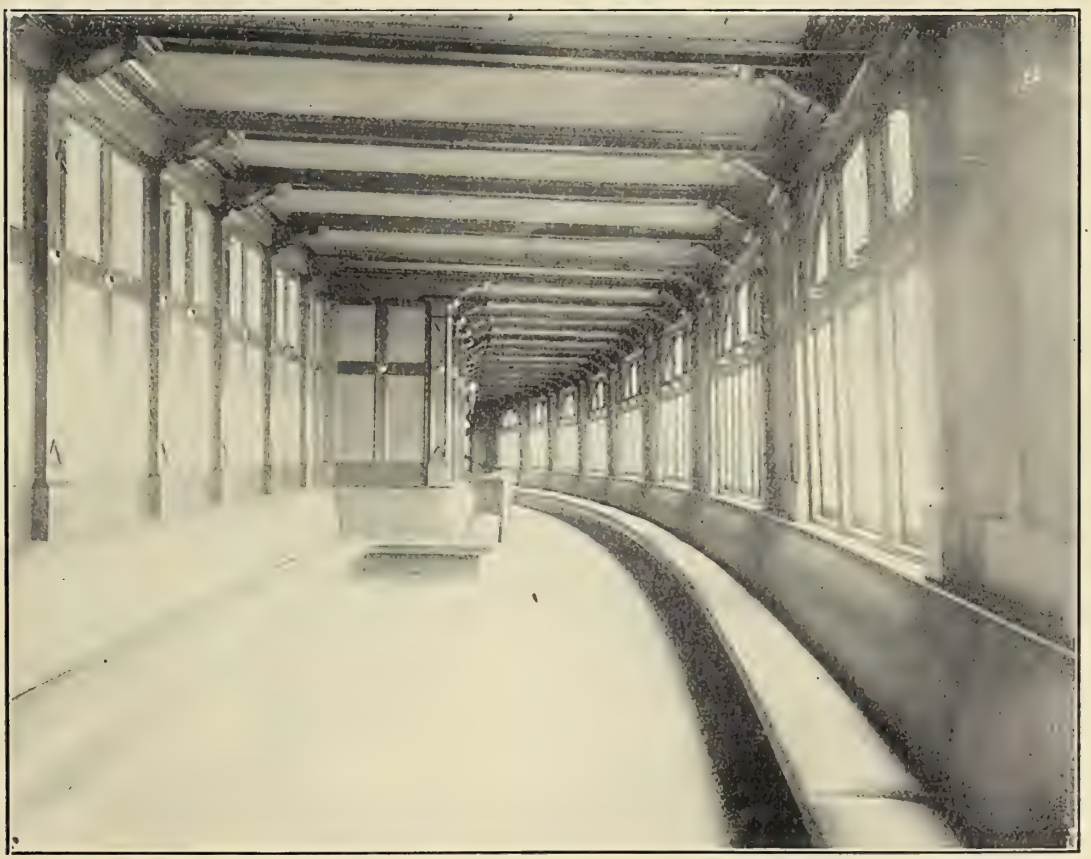
The main deck is in general of the usual arrangement. A cabin on each side extends the entire length of the boat, one being for smokers and one for non-smokers. Stairways in the centre of each cabin lead to the upper cabins. Between the main cabins are the usual teamways, with accommodation for thirty average wagons. For sanitary reasons the company experimented with a number of waterproof materials for the teamways, including rock asphalt, asphalt mastic, vitrified brick, granite block, and compressed cork brick, but these were found unsatisfactory on account of horses slipping on them when starting heavy loads. The paving material used is creosoted spruce, which is an improvement over the untreated wood. A portion of the center house between the teamways is used as a drivers' cabin, enabling these men to have a shelter in winter and still be close to their teams. The upper cabin is divided into two compartments, with large bay windows for general use. The promenade deck is provided with the usual seats.

Great care has been taken in the design of the interior finish. All cabinet work is of specially selected quartered white oak with plain moldings, giving a

New Steamers to the Orient.—A new line of freighters, to run between Seattle and the Orient, will start operations on the first of August. The first vessel to make the run will be the *Shawmut*. She will be followed by the *Lyra, Hyades, Pleiades,* and *Fremont,* all of which vessels are owned by the Boston Towboat Company.

Merchant Ships Docking at Algiers.—The Navy Department, under date of April 23, has issued a code of rules covering the docking of merchant vessels at the Naval Station, New Orleans. A charge of 20 cents per gross ton for docking and 10 cents per gross ton for demurrage for each and every day that the vessel remains on the dock will be made. No vessel whose displacement is less than 1,500 tons will be taken on the dock except in case of emergency.

Steamer Shortened.—An unusual dry dock operation is being performed by the Baltimore Marine Railway upon the propeller *F. W. Brune*, belonging to the Philadelphia and Baltimore Steamship Company. The steamer has been running on the outside route from Baltimore to Philadelphia, and as it is desired to run her on the inside route through the Chesapeake and Delaware Canal, she must be shortened 25 feet in order to pass through the locks in the canal.



VIEWS IN THE UPPER AND LOWER CABINS OF THE FERRYBOAT EDGEWATER.

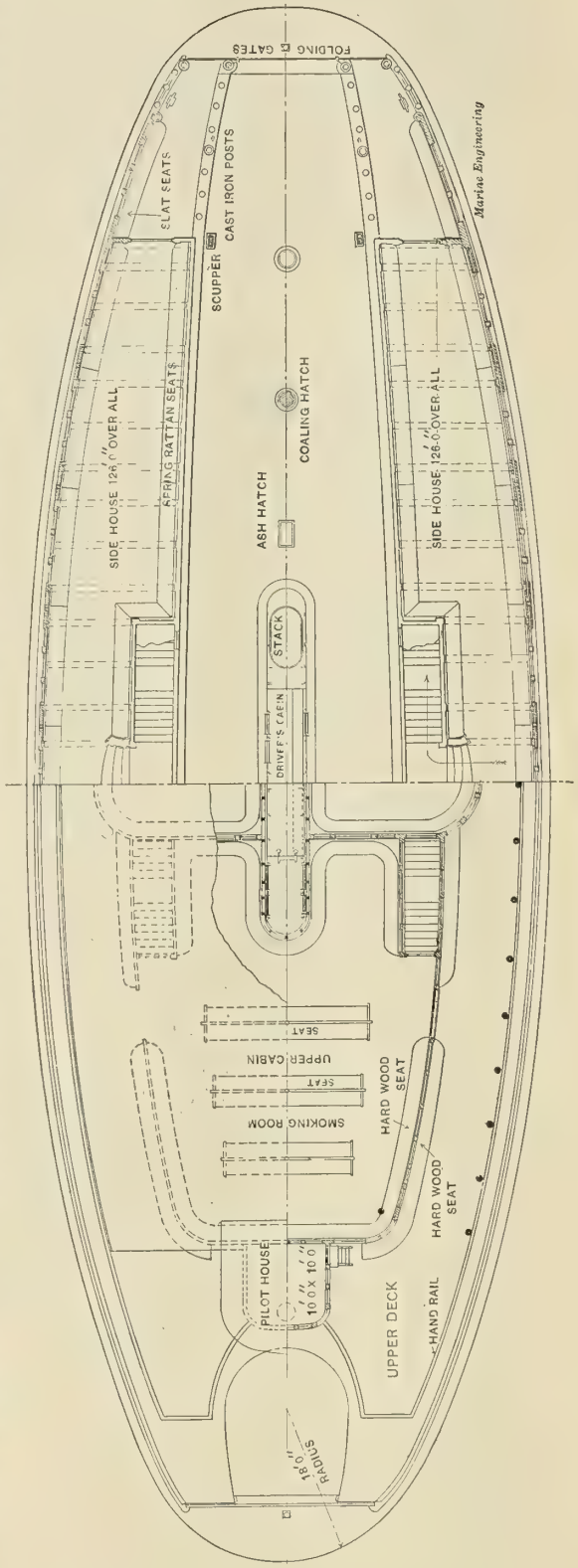
simple though elegant effect. The paneling of walls and ceilings is in burlap of natural color. A touch of bright color has been added in the elliptical transom windows of the lower cabin, which are of stained glass made by the Tiffany Company. The hardware and fixtures are of solid bronze. The color scheme is uniform throughout, harmonizing with the natural wood color of the oak. The lower cabin and stairway floors are covered with rubber tiling in a simple design, and the upper cabin floors with cork carpet. Spring rattan seats similar to those used in street cars are provided in the lower cabins, these affording additional comfort.

The boat is heated by the Sturtevant hot-air system. Cold air, which is taken in at an opening above the center house on the hurricane deck, is heated by being passed over steam coils in the hold, and is then blown into the cabins from outlets near the ceilings. Upon cooling, the heated air descends and is exhausted at openings under the seats and discharged into the open air by ventilating fans. The improvement over the usual system of heating by radiators under the seats, without any ventilation, is readily noticeable.

The hull is built of mild steel upon the vertical plate keel system, keel being 20 inches deep. As the vessel is of course a double-ender and has one propeller at each end, the stem and stern posts are the same at both ends and are made of cast steel, each in two solid castings, the frame being 4 by 6 inches. The rudder is of the double plate type, with 7-inch forged stock. The frames are 3 1-2 by 3 inches by 6.7-pound angles spaced 22 inches. The reverse frames are 2 1-2 inches by 5.1 pounds on every frame. Floors are of 12 1-2-pound steel, 13 inches deep at center, increased in weight under the engine and boilers. Rider plate is of 17 1-2-pound steel, 20 inches wide, and the four keelsons on each side of the vessel are each of double 4 by 3 inch by 8 1-2-pound angle, located as shown in section. Besides the two transverse collision bulkheads, there are two water-tight longitudinal bulkheads extending between the transverse ones and 12 feet 6 inches from the center line on each side of the vessel. The space formed by these bulkheads, which is about 131 feet in length, is divided into eight compartments, four on each side of the vessel. There is also a transverse sheet-iron bulkhead between engine and boiler rooms. In the outside plating it is noted that above the water line the strakes are increased in depth at the ends, so that the water-line strake is horizontal.

The deck beams are 5 by 3 inches by 12.7-pound angles, placed on every frame, except that above the midship bulkhead and at the ends of the midship house, heavy I-beams are placed. The beams on the guards are of Z section, 5 by 3 1-4 inches by 12 1-2 pounds, spaced 44 inches, and bracketed to the hull. The deck stringer plate is halved over the guard beams and riveted to them. The deck in the teamways is of yellow pine sheathed with yellow spruce. A steel deck is worked over the engine and boiler space.

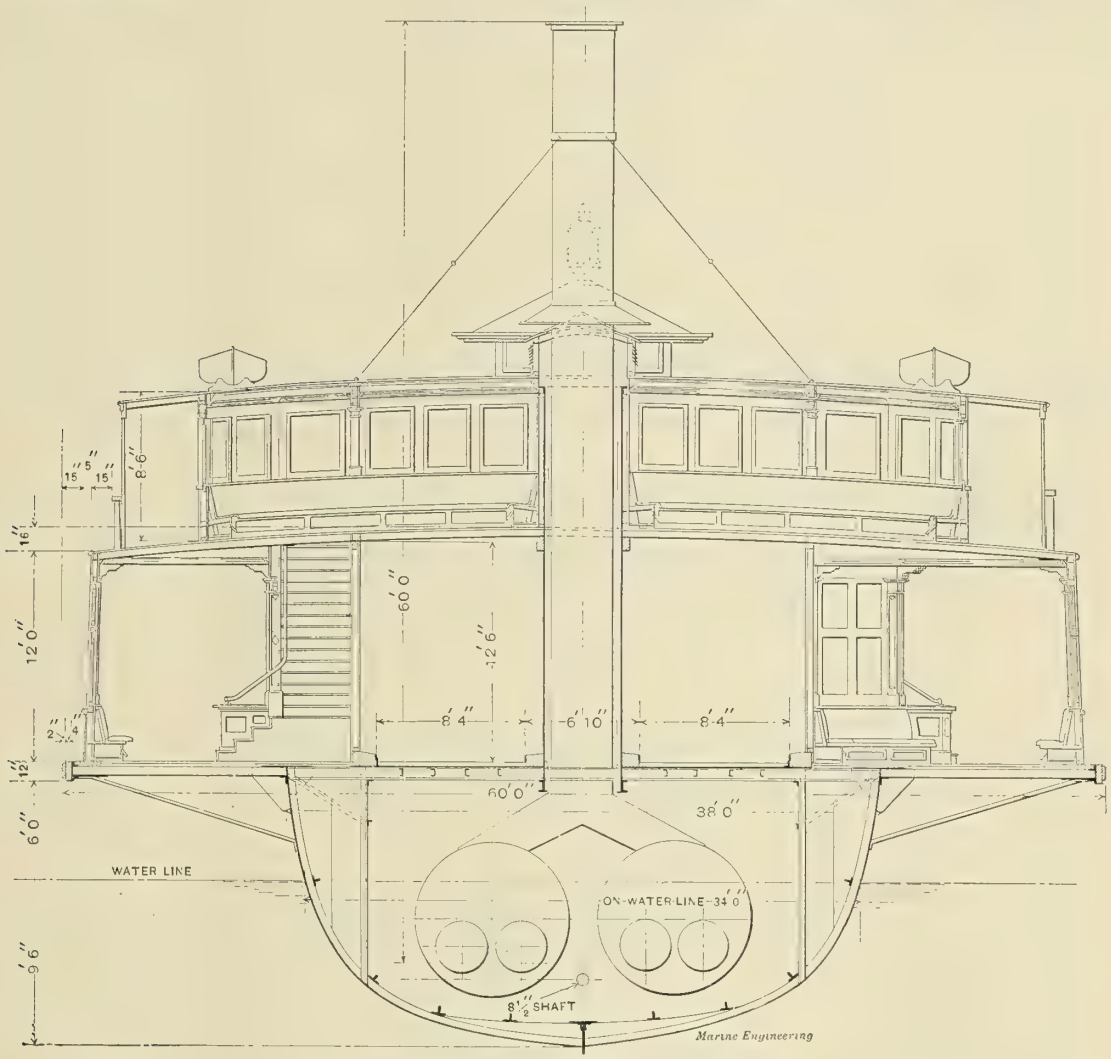
The deck and guard stringer bars are of angle section. The braces under the guards are on every beam and are of 2-inch oval iron, flattened at the ends. The plankshear is of oak, 3 1-2 inches thick and 18 inches wide, fastened by through bolts to the guard stringer



CABIN PLAN OF THE FERRYBOAT EDGEWATER.

bar. The fender is made up of staves of white oak 3 inches thick, faced with two widths of 3-4-inch iron, and from the ends of the staves is run a white-oak fender 4 by 12 inches, faced with a white-oak wearing piece 2 by 10 inches. The two fantail beams are of heavy angles, from which are worked 16 Z-bar radial beams, while the ends are covered by heavy plate and angles. A lattice girder is worked in between the collision bulkheads and the fantail beams on line with each longitudinal bulkhead.

square-column frames, with two legs under each cylinder. The bed plate is also of the box-girder form. The crank shaft, 8 5-8 inches diameter, is of built-up steel forgings. The pistons are of cast iron and the rods open-hearth steel forgings 7 1-2 inches diameter. The crossheads are of forged steel with crucible steel pins. The reversing gear is of the Stevenson type, operated by a steam cylinder. The steam exhausts into a Wheeler condenser mounted on a Blake compound air and circulating pump. The diameter of the steam cylin-



MIDSHIP SECTION OF THE FERRYBOAT EDGEWATER.

The cabin decks are laid in yellow pine, and the wings with white pine. The center house is of 7-pound plate and extends up to the hurricane deck. Under each pilot house is built the steering column, of lattice pattern, so arranged as to carry the weight of the pilot house and to accommodate a hand and steam steering gear. The safety gates furnished at each end are of the pantograph lattice style, supported by iron posts.

The three-cylinder compound engine drives through the continuous line of shafting a propeller at either end of the vessel. The high-pressure cylinder is fitted with piston valve, and the two lows with double-ported slide valves. The engine is supported by cast-iron

der of pump is 12 inches, air cylinder 14 inches, water cylinder 14 inches, and the common stroke is 10 inches. A closed feed-water heater to raise the temperature up to 180 degrees by the use of the auxiliary exhaust is installed. There are two thrust bearings, one forward and one aft of the engine, of the horseshoe type, with eight forged collars and nine shoes each. The line shafting is 8 inches in diameter, and the propeller shaft 8 1-4 inches. The stern bearings are 1-2-inch brass liners with lignum vitæ staves 3 feet long. The usual form of stern tube is used.

There are three steam pumps and one hand pump, the feed pump being 7 1-2 by 4 1-2 by 10 inches. The fire

pump is horizontal duplex, with cylinders 8 and 5 inches by 12 inches stroke. The bilge pump is worked from the end of the circulating pump rod. There are two sets of steam steering gears, with columns from the pilot house and leads taken to the quadrants.

There are two Scotch boilers, furnishing steam at 125 pounds pressure, and in each are 170 lap-welded 3-inch tubes 8 feet 6 inches long. There is one steam drum 3 feet in diameter, 8 feet 3 inches long, made up of 3-8-inch plates. Steam enters the drum from each boiler through nozzles at the lower part and leaves the drum through one nozzle at the top.

There are two electric generators located in the engine room, one of 10 and the other of 25 kilowatts capacity, direct-coupled to vertical engines, the voltage being 125. The electric lighting system is very complete, there being about 50 per cent. more lamps used than on the best-lighted ferryboats in the harbor.

To insure the success of the boat a corps of engineering specialists was engaged in its design, Col. E. A. Stevens, of Hoboken, Capt. C. W. Woolsey, and Mr. H. B Roelker supervising the design of the hull and machinery, and Messrs. Ford, Bacon, and Davis the electrical equipment and interior arrangement and finish.

At a later date we expect to publish the full results of the acceptance and progressive trials recently conducted by Col. Stevens.

The Stern-Wheel Steamer Alianza.

Herewith are presented the drawings and description of the steel stern-wheel steamer *Alianza,* built by the Pusey and Jones Company, Wilmington, Del., for service in Venezuela. This vessel is another evidence of the hold that our shipbuilders are taking upon the trade of South America. The *Alianza* was erected at the yards of the builder, and then taken apart in sections and shipped complete by sailing vessels to the point of destination, where the parts were assembled and the vessel placed in commission.

The hull is of steel, built as light as possible consistent with the proper strength, and of good model. The chief objects considered in her design were speed and light draft.

Four transverse water-tight steel bulkheads divide the hull into five compartments. Large hatches lead down to compartments two, three, and four, and small hatches into the end compartments. The vessel is stiffened longitudinally by a hog frame, with tie rods to support the end weights of boiler, engine, and stern wheel, the arrangement of which is shown on the elevation. On the main deck, forward, are a steam capstan and a double stairway leading to the promenade deck. Aft of this, on the centre line, is a boiler of the locomotive type, fired at the forward end.

Name—Edgewater. Nationality—American. Type—Ferryboat.

Launched—1902. Builder—Harlan & Hollingsworth Co. Owner—N. J. & H. R. R. & Ferry Co.

Length over all	180 ft.
" between stems	176 " 6 in.
" stern posts	146 " 6 "
Beam, molded at deck	39 " 9¼ "
" over all	60 "
" at water line	34 " 2 "
Depth, molded	15 " 6 "
Draft to bottom of keel	10 "
Freeboard at end	6 "
Engines, number of	1
Type	3 cylinder, compound
Cylinder diameters	22, 30, 30 in.
Stroke	24 "
Designed R. P. M.	150
" I. H. P.	850
Speed	12 knots
Condensing surface	1,250 sq. ft.
Propellers, number of	2
Material	Solid cast steel
Blades	4
Diameter	8 ft.
Pitch	8 ft.
Area	
Boilers, number of	2 single end Scotch
Pressure	125 pounds
Diameter	10 ft 6 in.
Length	11 " 6 "
Furnaces	2 each
Diameter	42 in.
G. S. total	92 sq. ft.
H. S. total	2,940 " "
Draft	Natural
H. S. ÷ G. S.	30.87
H. S. ÷ I. H. P.	3.46
I. H. P. ÷ G. S.	9.24

Name—Alianza. Nationality—Venezuelan. Type—Stern-Wheel Steamer.

Launched—1902. Builder—Pusey and Jones Co.

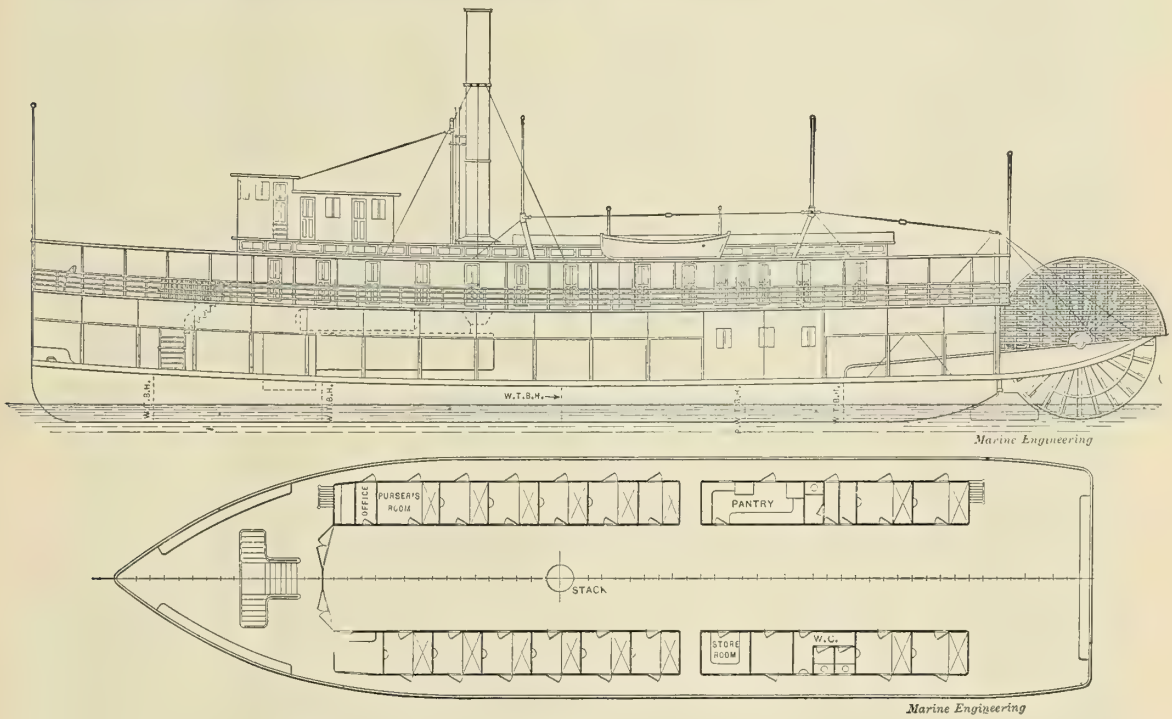
Length on deck	137 ft. 0 in.
Beam, molded	27 " 6 "
Beam over guards	34 "
Depth, molded	5 " 6 "
Draft, loaded	48 "
Engines, number	2
Type .. Single, high pressure, non-condensing.	
Cylinder, diam	18 in.
Stroke	72 in.
Speed, in still water	15 miles.
Boilers, number	1 locomotive.
Pressure	150 lbs.
Diameter	5 ft. 3 in.
Width of front	6 ft. 3 in.
Height	8 ft.
Length	33 ft
G. S.	28 sq. ft.
H. S.	2,161 sq. ft.
Tubes	2 sections of 2½-inch tubes.
Number of, in each section	155
Length	5 ft. and 14 ft.
Steam dome, diam	36 in.
Length	18 ft.
Wheel, material	Arms and buckets yellow pine, rims iron.
Diameter	21 ft.
Depth of buckets	18 in.
Width of buckets	14 ft.
Number of buckets	18

Abreast and aft the boiler the main deck is open for carrying freight, and on the port side is a small house containing store room and mess room, and in a corresponding house on the opposite side is the kitchen and store room. Two high-pressure, non-condensing engines are located at the stern, one engine on either side driving the stern wheel. The engine room is not enclosed, and a small house at the stern is used for the engineers' stores.

The arrangement of the promenade deck is such as to insure comfortable quarters for the passengers. Two lines of state rooms, one on either side, extend aft from the forward stairway. In all, there are fifteen two-berth rooms, which open both outside and inside. In this house are also the purser's room, pantry, store room, toilet rooms, etc. A bulkhead runs between the two tiers of rooms at the forward end, but the cabin is open at the after end and amidships to the outside deck. A skylight extends the length of the cabin, admitting air and light. The pilot house is located on the deck above, the forward end being in line with the forward end of the cabin. Aft of the pilot house are the captain's, pilot's, and engineers' rooms.

Each high-pressure engine has a cylinder 10 inches in diameter and 72 inches stroke, fitted on a strong steel frame on the main deck and connected at right angles to the main shaft. Slide valves worked by a link motion are fitted, and each cylinder has an independent cut-off. The wheels are of the radial type, with iron rims, yellow pine arms, and buckets of yellow pine in two lengths, the buckets on one side being placed half way between those on the other. The shaft is of steel, and five cast-iron centre hoops are mounted, on each of which is fastened a steel plate; the center rows of arms for one of the sets of buckets is made in short lengths. The wheel is covered by a wooden wheel house.

The locomotive boiler above referred to is in two sections, with a combustion chamber placed between them. There are 155 2 1-2-inch tubes in each section, 5 feet and 14 feet long, and the total length of the boiler is about 33 feet and the diameter 5 feet 3 inches. A steam dome 33 inches in diameter and 18 feet long is placed above the boiler. The boiler was built according to the U. S. Steamboat Laws for a steam pressure of 150 pounds.



ELEVATION AND PLAN OF A SOUTH AMERICAN STERN-WHEEL STEAMER.

Naval Manœuvres.—The Navy Department has issued orders for assembling next winter the vessels of the North Atlantic, South Atlantic, and European stations to participate in the West Indies in the most extensive fleet manœuvres ever attempted by the Navy. The list of vessels which will take part includes seven first-class battleships, two armored cruisers, eight protected cruisers, and five small cruisers, besides all available torpedo boats, colliers, and supply ships.

Catamarans.—The Jenks Shipbuilding Company is building for the United States Lake Survey seven catamarans, each 40 feet in width. Each catamaran has two large steel cylinders 30 feet long and 40 inches in diameter. When completed the catamarans will be fastened together, side to side, and be used for sweeping parts of the St. Lawrence river to ascertain obstructions to navigation. Weights with poles attached will be lowered between the catamarans and the various depths noted at the water line on the poles.

DOCKING FACILITIES ON THE PACIFIC COAST.

BY WILLIAM H. CRAWFORD, JR.

The eyes of the commercial world are now looking toward the Pacific Coast of the United States as the most promising field of future development in the most prosperous country in the world.

With the growth of Oriental countries and the extension of our commercial relations to these nations, as well as to our new island possessions, we can see in the near future a great merchant marine on the Pacific. San Francisco is, without doubt, destined to be the metropolis of the Western World. Its natural advantages assure this fact, and the works of man all tend to provide for the wonderful developments of the future.

Up to the present time one of the greatest needs has been proper provision for docking ships, there being but two dry-docks of any importance in the harbor of San Francisco, one at Mare Island Navy Yard and the other at Hunter's Point. Within the last few months, however, work has been started on two new docks which, when completed, will rank among the largest in the world, capable of handling any ships now afloat, with a margin to spare for what the next few years may bring forth. One of these new dry-docks is located right beside the old one at Mare Island Navy Yard, and, strange to say, the other is as close to the old Hunter's Point dock as safety will permit. This latter fact is the result of certain natural conditions that make it an interesting subject for investigation, and which further attract us when we know that while the work here will cost in the neighborhood of $500,000, it will take about $1,800,000 to accomplish the same end at Mare Island Navy Yard. Both docks will be of the same size when completed, 750 feet long, 122 feet wide at the top and sloping down to 74 feet at the bottom, with a depth of 32 feet of water in the dock at high tide. The illustrations here shown are all views of the work now being prosecuted on Hunter's Point Island.

Many centuries ago a rocky island lay a few hundred yards off the bay shore in the neighborhood of San Francisco's present site, but by a change of currents this channel was gradually filled up, until at the present time we have a prominent head of land connected with the main shore by a less prominent and low-lying strip. This is the Hunter's Point of to-day. The old dock and the new one are both cut out of the solid rock which forms a natural basin, and open into water with a depth of about of 40 feet.

The first illustration is a view of the excavation looking toward the future opening. At the right-hand wall of the excavation the strata of rock slope down toward the front and indicate the bed of an old-time channel between the rocky head and the mainland.

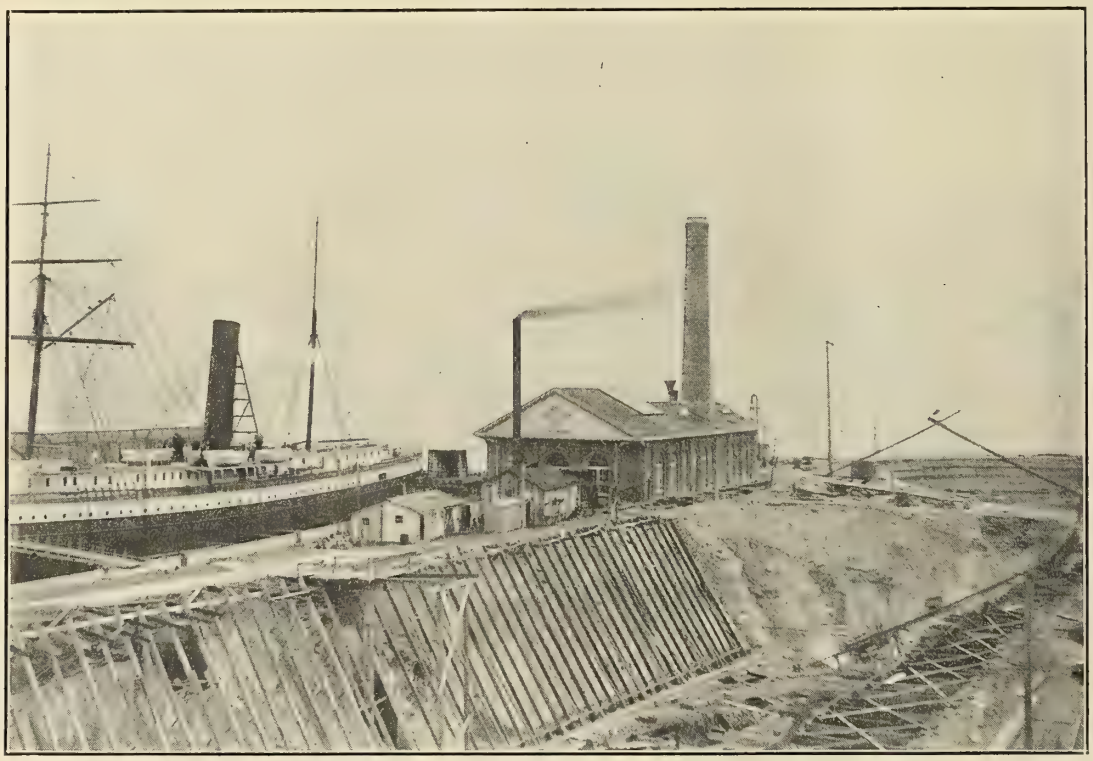


FIG. 1.—VIEW OF NEW DRY-DOCK AT HUNTER'S POINT, SAN FRANCISCO BAY.

Illustration No. 2 is also a view of the natural rock basin looking inland from the water end. This portion of the dock is about ready for its cement lining, and the upper end, it will be seen, has already received its coating. The sides of this dock will not be stepped as with the old one, save for seven steps at the bottom and four at the top. Between these the walls will be flat. There will be four places on each side where stairways will be built to allow access to the bottom of the dock.

A pile driver may be seen in the left-hand background of this picture, and it was from the top of this that view 1 was taken. Here may be seen the

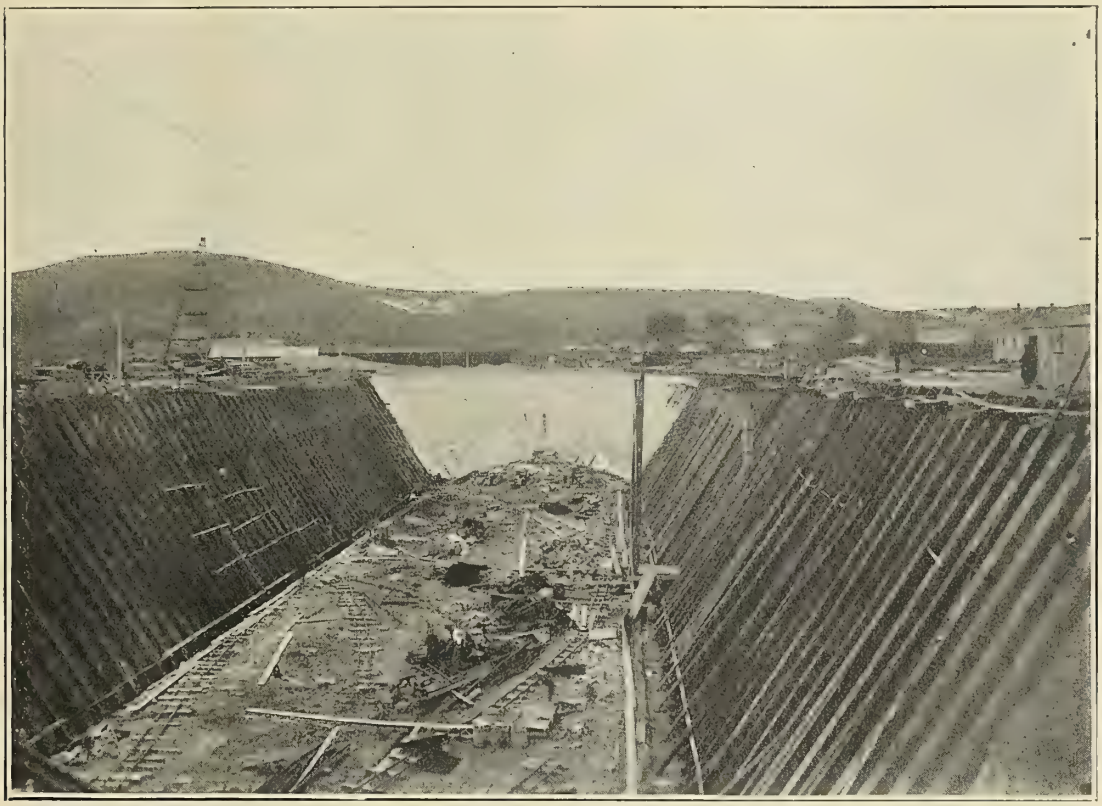


FIG. 2.—NEW HUNTER'S POINT DRY-DOCK FROM THE BAY.

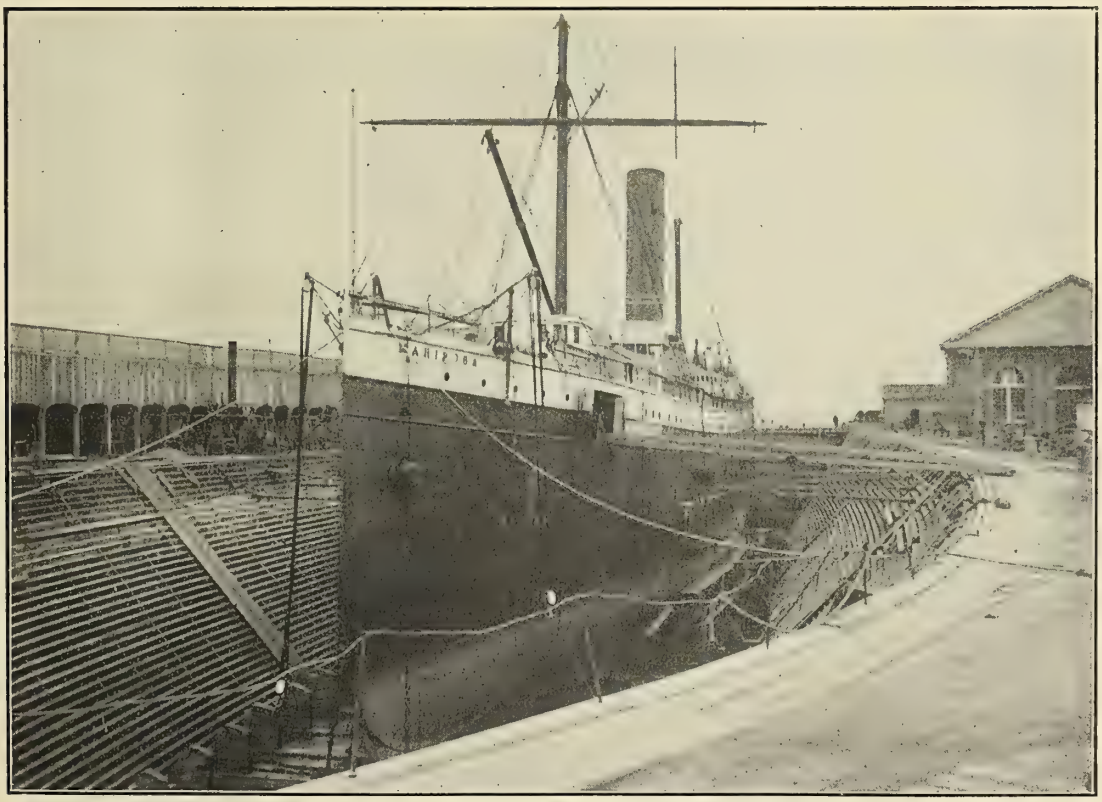


FIG. 3.—OLD DRY-DOCK ADJOINING THE NEW HUNTER'S POINT DOCK.

pump house, located between the two docks, also the portion of rock that has yet to be cut away, and the close proximity of the old dock in which there is a steamer. A cofferdam is built around the future opening of the new dock, which shows up very well in No. 1. A faint glimpse of the upper end, the cemented portion of the new dock, is also visible in this picture. Illustration No. 3 gives an idea of what the old Hunter's Point dock looks like and shows on the blocks the old *Mariposa,* the steamer referred to above. She is one of the pioneer ships sailing from this port, and, with the *Alameda,* has been variously engaged in the Australian and Hawaiian service since 1882. At present this vessel is being overhauled by the Risdon Iron Works and converted into an oil-burning ship. She will be the second ocean craft regularly leaving this port and burning liquid fuel, the first being the S.S. *Enterprise,* which is at present engaged in the Hilo, Hawaiian Island, trade.

The old dock shown in this picture has done great service in its day. The U. S. S. *Oregon* was able to squeeze in here with a 4-inch margin after her rudder had been removed. No such troubles will be experienced with the new one, however, for many years to come, and its great size will not necessarily retard the work of docking, for it is estimated that with the present pumping plant a ship can be docked in about one hour and twenty minutes. There are three centrifugal pumps with a total expelling capacity of 180,000 gallons of water per minute. These pumps are fitted with rope-drive pulleys, a constant tension being kept on the rope by the usual weighted compensating wheel.

For those who are interested in the future development of this great port we can promise much to be seen in the years to come. The great work of the Santa Fé Railroad in filling in the China Basin will probably be eclipsed by some greater undertaking. The San Francisco *Chronicle* sounds a note of warning in an editorial under date of May 26, "More Water-Front Facilities," which says in part: "Everything points to the fact that the Harbor Commission will be called upon at an early date to rearrange the entire water-front facilities of this port to accommodate the increased demands of commerce. It cannot be undertaken too soon. *The growth of ocean commerce here is unprecedented.* New steamship lines, with vessels of the largest tonnage, are being created which contemplate making San Francisco their home port. A new ferry line across the Bay is in sight. The sail fleet is increasing as fast as half a dozen busy shipyards can comply with the orders of their customers. Facilities for this increased shipping must be provided. What are we going to do about it? This is the question before the Harbor Commission. The question cannot be dodged. We are confronted on the water front with a condition, not a theory."

American Registry.—It is stated that many vessels flying foreign flags are being transferred to the Danish flag, with the Danish West Indies as their home port. This is done with the expectation that Congress will ratify the treaty of the purchase by the United States of the Danish West Indies, when all vessels registering at that port will pass under the American flag.

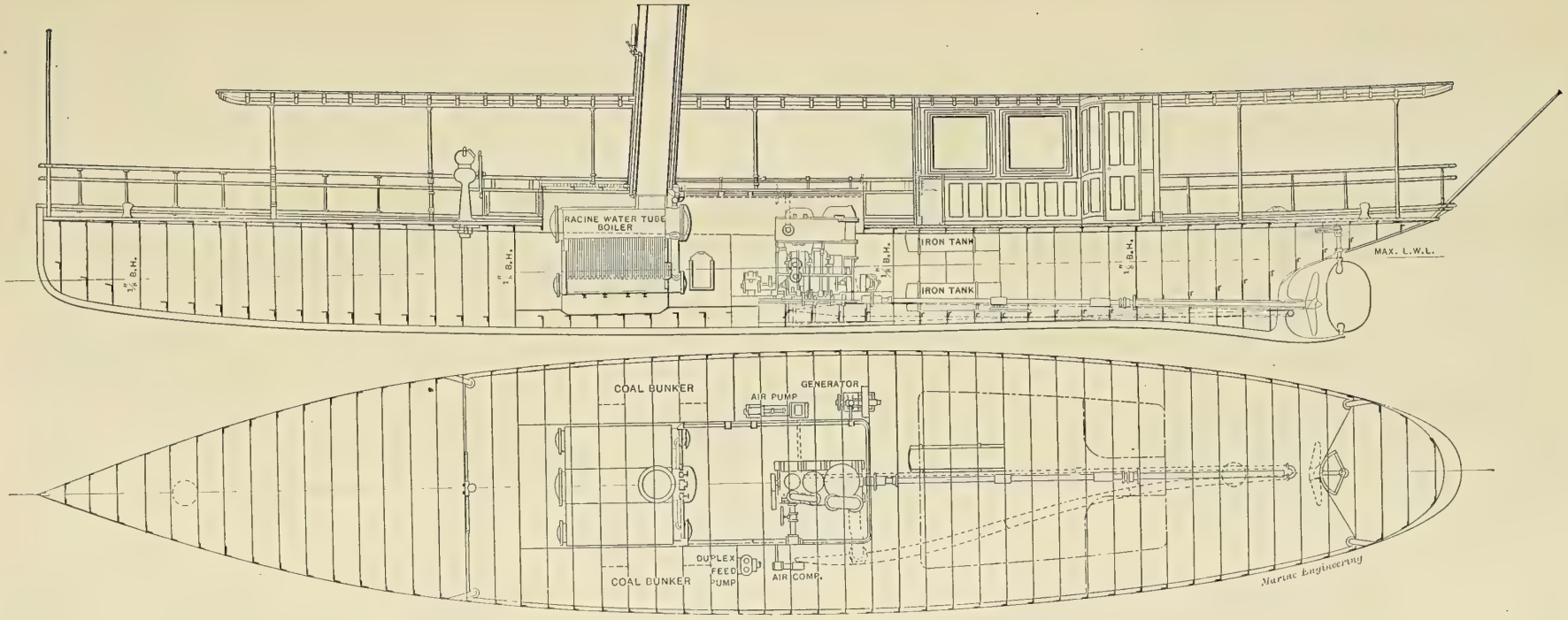
A STEAM YACHT FOR LAKE SERVICE.

The building of small steam yachts for cruising on inland waters is developing at about the same rate as that of our coasting yachts. The description and drawings of the 75-foot steel steam yacht *Louise* herewith presented are of a craft which represents a type of boat that has become very popular upon the lakes of New York State, and is designed primarily for a day boat. The vessel was built by the Racine Boat Manufacturing Company, of Racine, Wis., for Mr. John J. Mitchell, of Chicago, to be used by the latter gentleman on Lake Geneva, N. Y. The principal requirement was that there should be plenty of deck room, with the largest proportion of the same forward of the machinery. The deck house is usually placed aft of the machinery space and built entirely above the deck, but on this craft the cabin is placed aft and the entire deck forward is clear. As will be seen from the plans, a cedar standing roof extends from within 10 feet of the bow to the stern. The general construction of the vessel is given in the following paragraphs:

Keel.—To be of flat bar steel, 5 by 1 inch, scarfed to receive stem and stern post. Stem and stern to be of steel, rabbeted to receive plating, scarfed and riveted to keel in a workmanlike manner. Stern to have proper eyes for shaft and rudder.

Frames.—To be spaced 17 inches apart and to be of steel angles 2 by 1 1-2 inches, furnished to exact shape and punched to receive plating, floors, and reverse frames. Reverse angles to be of steel, 1 1-2 by 1 1-2 inches, used on each frame, and to extend 12 inches beyond curve of bilge, except in engine and boiler room, where every alternate one extends to sheer of vessel. Floors to be of steel plate 3-16 and 7-32 inch, securely riveted to frames and reverse angles. Deck beams to be of angle steel 2 1-4 by 1 1-2 inches, fastened to frames by means of gusset plates, and to be placed on each frame. Gusset plates of steel plate 3-16 inch thick amidships, 1-8 inch forward and aft, securely riveted to frames and deck beams.

Plating.—To be used as wide and long as shape of yacht will allow, so as to avoid laps and butts; all plates being lapped athwartships; all butts fore and aft to be flush. Garboard plate to be 1-4 inch thick, double riveted to keel, stem and stern, with 1-2-inch rivets. Sheer plates to be 7-32 inch thick amidships for one-half length of vessel, 3-16 inch forward and aft; to extend 8 inches on top of deck from bulwark. All other plates to be 3-16 inch for half lengths amidships, 1-8 inch forward and aft. Bulwark angle to be 1 1-2 by 1 1-2 inches, riveted to sheer plate. Riveting to be in a workmanlike manner, perfectly smooth on the outside, to be of either best Norway iron or mild steel. Keel, stem and stern, and all butts to be double riveted; the rest to be single. Deck stringer to be of 1-8-inch steel plate, 15 inches wide amidships, 10 inches forward and aft, and to be securely riveted to deck beams. Deck stringer angle to be 1 1-2 by 1 1-2 inches, riveted to sheer plate and deck stringer plate. Floor angles for hull forward and aft to be 1 3-4 by 1 1-2 inches, riveted to frame. Engine foundation to be of steel, constructed in such a way as to avoid vibration when engine is running at full speed.



PLAN AND ELEVATION OF STEAM YACHT LOUISE, BUILT BY THE RACINE BOAT MANUFACTURING COMPANY.

BULKHEADS.—Athwartships to be five in number and of steel plate 1-8 inch thick, stiffened with steel angles 1 1-2 by 1 inch, spaced not more than 24 inches apart.

RUDDER.—To be 5-16-inch steel plate, stock to be 2 1-4 inches diameter, forged to proper shape.

COAL BUNKERS.—On each side of boiler, of about three and one-half tons capacity, to be of steel plate 1-8 inch thick, stiffened with steel angles 1 1-2 by 1 inch, not more than 24 inches apart, and to have proper outlets to fire room and square gunmetal hatches in deck, one hatch to each bunker.

COVERING BOARD, or plankshеer, to be of sound white oak 6 by 1 5-8 inches, fastened with rivets to sheer strake and deck stringer plate.

DECK.—To be of selected, clear, well-seasoned, quarter-sawed white pine, free from sap, laid fore and aft, 1 1-4 by 2 inches, to be blind fastened and screwed from deck beam below, seams to be calked with cotton and filled with white lead. Deck hatches to be flush, 14 inches in diameter, of polished gunmetal, one forward and one aft, and fitted with grating and solid cover. Bulwark to be of best quality of white oak, 1 3-8 by 3 inches, fastened to rail angle from below with screws. Rails to be of mahogany, supported on brass stanchions, to have netting of best quality between and designed to suit owner.

SCUPPERS.—Main deck scuppers to be four in number, of 2-inch lead pipe, flanged at main deck and tacked down in white lead, lower end to be attached to plating 2 inches above the water line and made tight with a brass backing flange securely bolted to hull. Scuppers for upper deck to be two in number, located at lowest point of canopy top, and arranged to discharge into main deck scuppers located as shown on plans.

CANOPY TOP.—To be made light and supported upon turned stanchions of mahogany. Top to be covered with 10-ounce canvas and painted outside. Inside to be matched, of clear white pine, varnished. Head room between deck and canopy carlins, 6 feet 7 inches; carlins to be of selected mahogany.

CABIN.—To be 13 feet long and of such width as to give passageway either side on deck, to be of white pine, plainly paneled outside, and of Mexican mahogany with plain panels inside, including front of settees

and sideboard; to have French plate-glass windows; all windows to be stationary. Also stationary French plate-glass windows in each door and over sideboard. Top to be finished in white enamel and to have mahogany carlins. Cabin windows fitted with Pullman car curtains. Toilet room to be furnished like cabin and to have entrances from cabin, same to be furnished with one flush W. C.; also with porcelain bowl wash basin, with onyx marble slab and back; all plumbing to be open and nickel plated, and to be supplied with one 60-gallon capacity water tank and one 30-gallon capacity air tank, with Marsh steam air pump and gage. Settee in cabin to be upholstered with leather of the best quality, to be stuffed with best grade of curled hair. Sideboard to be arranged in forward end of cabin, to have drawers and lockers.

Steering Wheel.—Located about four feet from coaming, to give space for chair; constructed of mahogany, with brass trimmings on polished gunmetal stand, made hollow, fitted with bevel gears and Tobin bronze steering rod, with rack and pinion movement below deck, and quadrant on rudder. Bell pull and jingle bell to be arranged in stand.

Cleats and Chocks.—All necessary cleats and chocks, of proper size to securely moor boat, will be supplied and fitted in polished gunmetal.

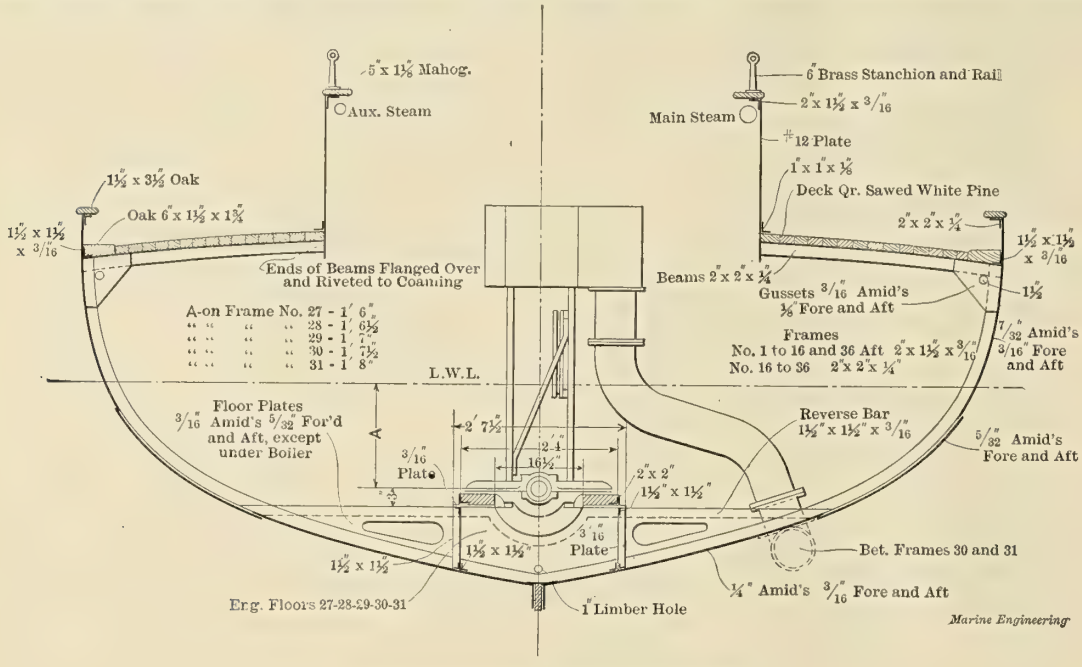
Anchor.—One 60-pound galvanized anchor with loose stock to ship below through flush hatch, and with suitable Manila lines.

Coaming.—Around engine and boiler room to be of steel plate. Top of boiler to be of steel plate, covered with a Mexican mahogany grating and lined with asbestos to enable it to be used as a seat if desired; a 6-inch brass rail to surmount mahogany rail on coaming.

Wales.—Or wearing strakes, to be of oak 4 inches wide, faced with 1-inch half-oval iron, securely fastened to hull at deck line and extending about two-thirds of length of vessel. To be tapered fore and aft and die away in lines of hull.

MACHINERY.

Boiler.—To consist of one Racine water tubular boiler, with bent steam generator tubes of seamless drawn steel, and to carry a working pressure of 250 pounds. The boiler will be about 5 feet square and have 19 square feet of grate surface and about 760 square feet of heating surface, and weigh about 4,000 pounds. Boiler to have ample air space between coaming, and coaming inside to be lined with asbestos. All fittings to be of extra heavy pattern, designed for 250 pounds pressure, and of the latest pattern. Boiler will be provided with triangular rolling grates and suitable shaker. Smokestack to be double, with 3-inch air space between each stack, constructed of No. 16 steel. Front head on boiler drum to be covered with large spun-brass head, with name of yacht engraved thereon.


5" x 1⅝ Mahog.
Aux. Steam
1½" x 3½" Oak
Oak 6" x 1½" x 1⅜"
1½" x 1½" x 3/16"
Ends of Beams Flanged Over and Riveted to Coaming
A-on Frame No. 27 - 1' 6"
" " " 28 - 1' 6½"
" " " 29 - 1' 7"
" " " 30 - 1' 7½"
" " " 31 - 1' 8"
L.W.L.
Floor Plates 3/16" Amid's 5/32" For'd and Aft, except under Boiler
3/16" Plate
2' 7½"
2' 4"
16½"
2" x 2" x 1½" x 1½"
3/16" Plate
1½" x 1½"
1½" x 1½"
Erg. Floors 27-28-29-30-31
1" Limber Hole
6" Brass Stanchion and Rail
2" x 1½" x 3/16"
Main Steam
12 Plate
1" x 1" x 1/8"
Deck Qr. Sawed White Pine
2" x 2" x ¼"
1½" x 1½" x 3/16"
Beams 2" x 2" x ¼"
Gussets 3/16" Amid's ⅜" Fore and Aft
1½"
7/32" Amid's 3/16" Fore and Aft
Frames No. 1 to 16 and 36 Aft 2" x 1½" x 3/16"
No. 16 to 36 2" x 2" x ¼"
Reverse Bar 1½" x 1½" x 3/16"
5/32" Amid's Fore and Aft
Bet. Frames 30 and 31
¼" Amid's 3/16" Fore and Aft
Marine Engineering

MIDSHIP SECTION OF LAKE-BUILT YACHT LOUISE.

Engine.—To be of the triple-expansion type of the size mentioned in the table, and to be of the very best material and with spiral reversing gear. Frame of polished-steel stanchions, the cylinders to be of best quality gray cast iron, connecting rods of polished gunmetal, crank shafts of best quality mild steel forged solid, crank boxes of polished gunmetal babbited, gearings of steel castings babbited, bed plates of best quality bar steel planed all over, crossheads of polished gunmetal, stuffing boxes of polished metal, cylinders lined with polished brass lagging all around, polished spun-brass covers top and bottom.

Condenser.—An outside keel condenser, made of copper pipe with brass flanges of suitable size, will be supplied and fitted with all proper connections pertaining to a first-class job.

Pumps.—Air pump is of the Dean pattern, 4 1-2 by 6 by 5 inches, properly fitted and connected. Feed pump is a duplex, 4 1-2 by 2 1-2 by 4 inches, and is made by Worthington. An injector is also supplied.

Shafting.—To be of best quality of cold-drawn steel, 3 inches diameter, to be in two lengths, connected together with clamp couplings of cast steel. Line bearings to be of cast iron, babbited and properly secured in vessel. Stern bearings to be of gunmetal, babbited, to be made long enough to give good bearing. Stuffing box to be of gunmetal. The propeller is 40 inches diameter and of bronze.

Electric Lighting Plant.—To consist of one high-speed automatic engine, direct connected to a 25-light latest improved dynamo; lamps and fixtures to be distributed in accordance with owner's wishes, and the entire plant to be of modern design and of first-class pattern. Outfit to be complete with switchboard and instruments, also 50-C.P. incandescent lamp with reflector arranged on top of canopy for searchlight.

FINISH.

The hull to be treated inside to one coat of red lead paint and one coat of anti-rust paint. Outside to have one coat of anti-rust paint and two coats of our composite green below water line. On top of water, hull to be treated to five coats of best quality of white lead. Cabin house to have three coats of white lead outside, and all the hardwood to be rubbed down in oil and pumice stone and finished in the best manner. Bulwark and rails to be finished natural in best spar varnish.

Name—Louise Nationality—American Type—Steam Yacht

Launched—1902 Builder—Racine Boat Mfg. Co. Owner—John J. Mitchell

Length over all	75 ft.	Condens. surf. outboard pipe	50 sq. ft.
Length L. W. L.	68 ft.	Vacuum	21 in.
Beam, extreme	14 ft.	Speed	14.5 statute miles
Draft	4 ft.	**Boilers,** number	1
Corresponding displacement (fresh water),	22.28 long tons	Type	Racine water tubular
		Pressure	250 lbs.
Area midship section	24.8 sq. ft	Size	5 ft. sq.
Block coeff	.41	G. S.	19 sq. ft.
Engines, number	1	H. S.	760 sq. ft.
Type	3 cylinder, triple expansion	Weight	4,000 lbs.
Cylinders, diameter	6¾, 10¼, 16¾ in.	**Propeller**	4 blades, bronze
Stroke	9½ in.	Diameter	40 in.
I. H. P., on trial, estimated	140	Pitch	55 in.
R. P. M.	425		

CARE AND MANAGEMENT OF THE MARINE GASOLINE ENGINE.—III.

BY E. W. ROBERTS.

There is nothing about a gasoline engine that requires more attention than the igniter. For this reason it is absolutely necessary that the operator give this part of the engine his most careful study, as, nine times out of ten, gasoline engine troubles are igniter troubles. But two forms of ignition are used in marine gasoline engines—namely, the hot tube and the electric spark. Practically all of the marine engines built in this country use electric ignition, there being but one exception, to the writer's knowledge—that is, there is but one marine engine made in the United States using the hot-tube ignition.

In Fig. 12 is shown the principle of the hot-tube igniter. It is merely a tube closed at one end and screwed into the cylinder wall of the engine, with its open end communicating with the combustion space of the engine. This tube, *t* in the figure, is heated by a gasoline burner *d*, the flame being guided by chimney *c*, so that it heats the tube to redness at a point in its length which is determined by the time in the stroke

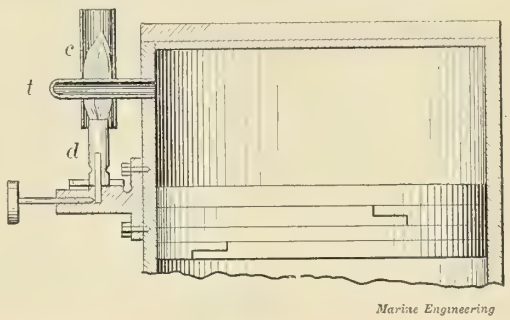


FIG. 12.

of the piston at which it is desired that ignition should take place. The most common form of tube igniter is that shown in the figure, and the principle of its operation is as follows: When the engine exhausts, it leaves the tube *t* filled with the products of combustion at about the pressure of the atmosphere. These prevent the fresh charge from reaching the hot portion of the tube until the charge is compressed to such a point that it drives the dead gas back in the tube past the heated portion and allows the fresh gas to come in contact with the igniting point, where it takes fire.

The time of ignition may be varied by changing the position of the flame on the tube, bringing it nearer to the open end, advancing the time of ignition, and *vice versa*. Again, shortening the tube will require a higher compression to drive the dead gases past the hot point and retard the ignition, while a longer tube will give earlier ignition. The tubes are made of ordinary gas pipe, of porcelain, of a special nickel-steel alloy, and also of platinum. The wrought-iron tubes last all the way from a few days to a few weeks, while the other substances mentioned may generally be relied upon to last for a season, or perhaps two. While cheap and simple, hot-tube igniters are generally considered troublesome and not suitable for marine engines, one great objection to their use being the necessity of

having an open flame on the exterior of the engine. In spite of these objections, the firm above referred to has been quite successful in their use, as is attested by the many operators of its engines.

Electric ignition, which is now so widely used, deserves the most careful study by the operator, and for this reason the writer will describe it in considerable detail. Two forms of electric ignition are used, one known as the primary make-and-break, and the other as the jump spark. The principle of primary ignition is as follows: If an electric circuit of any kind be suddenly broken, a spark will be formed across the gap. The nearest analogy to this is the thump that is heard upon the sudden closure of a hydrant, the sound resulting from the sudden stoppage of the stream of water. However, to better understand what really causes the spark, it is best to pass to the fundamental principles of electricity. Around every wire in which current is flowing there is a magnetic field similar to that around the poles of a magnet. If a conductor of electricity lies within the field of a magnet, any alteration in the intensity of this magnetic field caused by a corresponding alteration in the strength of the magnet will cause a current to flow in the conductor so long as the ends of the conductor are electrically connected. To return to the broken circuit, it will be seen that when the circuit is broken the magnetic field caused by the current flowing in the wire will immediately disappear. Now, since an alteration in a magnetic field about a conductor will produce a current in that conductor, it would seem that breaking the circuit would have a tendency to produce another current, and this is just what occurs. Further, this current is of so much greater pressure than that originally flowing in the wire that it will cause a spark to leap across the gap at the first instant of the break and before the gap is very wide.

The voltage—or, in other words, the pressure—of a current formed by the alteration of the magnetic field is in proportion both to the strength of the field and the rapidity with which the change is made. Thus, if the field is very strong and is rapidly diminished to zero, as by breaking a powerful circuit, the spark produced would be very much more intense than if the field were weaker or the break very gradually made. By winding a conductor about a core of magnetic metal such as iron, the magnetic field produced by the current is very much increased. Hence the reader will readily see that if an electromagnet forms a part of the circuit which is broken, the intensity of the spark will be very much increased.

In Fig. 13 is shown such a circuit supplied by a current from the battery of four cells *c, c,* flowing through the electromagnet or spark coil, a switch *s,* and a pair of igniter points *i,* returning thence to the battery. The spark coil consists of a number of coils of insulated wire *b,* wound about a bundle of fine iron wires forming the core *a.* The igniter points are separated at regular intervals by a mechanism on the engine, to be explained later, and, owing to the strong magnetic field of the coil, which is thus suddenly changed from its maximum to zero, a current of very high pressure is momentarily induced in the circuit and an intense spark is made at the break.

Ordinarily the igniter points are separated and brought together but a moment before the time required for the spark, in order that a current may not be flowing continuously through the circuit and thus waste the energy of the battery. For this same reason the switch *s* is introduced in the circuit in order that the current may be turned off entirely when the engine is not in use. Occasionally the mistake is made of not bringing the igniter points together a sufficient length of time before the spark to give the best effect. Every spark coil requires a definite, although short, interval of time to become fully magnetized. As the intensity of the spark depends directly upon the strength of the magnetic field, if the field has not time enough to build up, the spark will be weakened in consequence. Short coils become magnetized more quickly than long ones, but require a little more current for the same magnetic strength than the long coils. Hence a short coil should be used for a high-speed engine, a 6-inch coil being that most generally employed for the modern marine engine.

Failure of the igniter to operate may be due to one of several causes, and occasionally to several combined. In the first place, the circuit may be broken either by a connection becoming loose or a broken wire. Quite often the wire will break inside the insulation or cov-

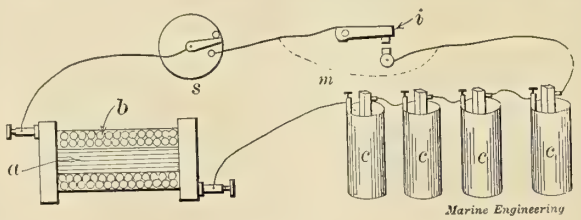


FIG. 13.

ering, and to all outside appearances be perfect. This can be discovered by using another wire and bridging around that which is supposed to be broken. A careful inspection of the connections will show whether the fault is in them. A very annoying fault is a loose connection which is in contact so long as the engine is idle, but which is jarred out of position by the vibration of the engine when it is running. Poor contact is very often produced by corrosion or by the igniter points not being pressed firmly enough together. Occasionally there is a shunt, as indicated by the dotted line at *m,* Fig. 13, which allows the current to flow past the igniter when the break at the igniter points will not produce a spark. This may be tested by noting if the circuit is complete when the igniter points are held apart. If current is still flowing, it indicates a shunt, which is quite often the fault of the insulation of the stationary igniter point. Another fault is a weak battery, which can be determined by bridging the terminals of the cells with a piece of wire and scraping one end of the wire across a terminal, when a slight spark should be given if the cell is in good condition. This test may also be made by bringing the ends of the two wires connected with the cell terminals in close proximity on the tongue, when the current will be felt. A still better method is to use a small voltmeter, called a battery tester, which will indicate directly the strength of the

cell. If but one cell is at fault, it may be cut out by bridging with a piece of wire, and quite often the engine may be run for a short time with the remainder of the battery.

In Fig. 14 is shown one of the simplest forms of the make-and-break igniter, usually called a piston igniter. The terminal *i*, usually called the insulated electrode, is provided with a mica bushing *m* and two mica washers *n*, which prevent it coming in metallic contact with the engine. A rocker arm *r* rotates in a sleeve *s*, being held normally in contact with *i* by means of the spring *a* on the outside of the engine, one end of the spring being fast to the clip *c* on the shaft of *r*, and the other end being fast in the outer end of the sleeve *s*. As the piston approaches the end of its stroke, the pin *p* strikes the arm *r*, separating the platinum points *b*, thus breaking the circuit and producing a spark between the points. In the form shown, the current passes to the arm *r* from the engine itself, one terminal of the circuit being attached to any convenient point on the engine, the current flowing through the metal. This is called grounding one side of the circuit and is customary in practically all forms of gas-engine igniters. Such an igniter has

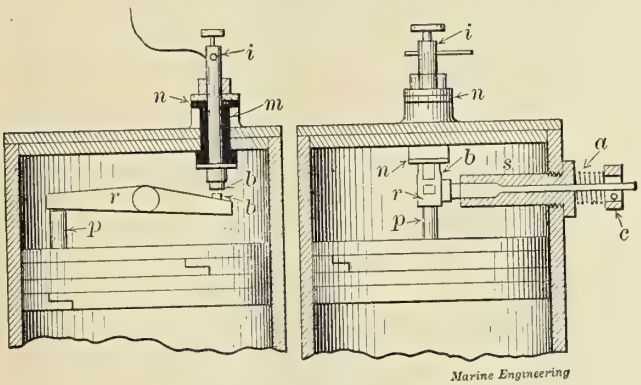


FIG. 14.

the circuit closed, except from the moment of the break to the time the pin *p* releases the rocker arm. Quite frequently a circuit breaker is provided, which is attached to the crank shaft on a two-cycle engine, or to the cam shaft on a four-cycle engine, the circuit being closed just long enough before the break to allow the spark coil to pick up. If the circuit breaker is not used, a dynamo should be employed to provide current sufficient for the igniter, as it will very soon run a battery down.

In Fig. 15 is shown the outside mechanism of an igniter which is operated from an eccentric and closes the circuit only long enough before the break to charge the spark coil. The rocker arm has a lever *l* on the outside of the cylinder, which is held against the stop *h* by means of the spring *s*, so that the electrodes inside the cylinder are separated. The eccentric rod *p*, coming in contact with *l*, forces the electrodes together, and after the points meet further movement of *l* compresses the secondary spring *k*. The arm *l* rotates freely about the rocker shaft, and the arm *m*, being fast to the rocker shaft, is moved only through the spring *k*. As the eccentric rotates in the direction of the arrow, the lower end of *p* is carried to the right, consequently the upper end passes to the left until *l* slips off and flies back against the stop. The spring *k* and the arm *m* are carried with it, and the circuit is broken with a snap. Further rotation of the eccentric draws *p* downward, the upper end passing far enough to the left to clear the end of *l*. There are quite a number of igniters that operate on this general principle, and all of them bring the electrodes in contact for a short time only, thus avoiding waste of the battery.

Another variation of the make-and-break is what is known as the wipe spark, and is illustrated in principle in Fig. 16. The stationary insulated electrode *s* is provided with a spring, and the movable electrode *m* rotates once for one cycle of the engine. It is provided with a lug *l*, which comes in contact with a spring *s*, deflecting it until finally the spring snaps off the lug and a spark is formed. This igniter has several objectionable features. The spring will not hold its tem-

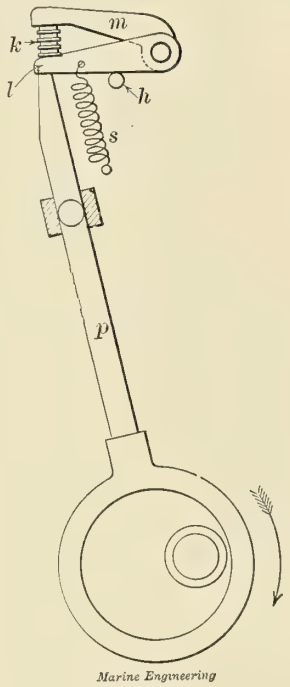


FIG. 15.

per when exposed to the high temperature of the combustion in the cylinder, and, if the spring be placed outside, the movement of the arm in the insulation is inclined to displace it. The principal objection, however, is the rapid wear of the contact, owing to the rubbing. It is absolutely necessary to devise some means of feeding the spring as it wears, and this necessitates constant adjustment and interferes with the timing of the spark.

The jump-spark igniter owes its development to the automobile, for which it has been adopted principally because there are no moving parts in the engine cylinder, and therefore it is better adapted to the high speeds in use on that form of engine. It is gradually finding favor among marine engine builders, and the writer knows of one manufacturer who is using it exclusively, this year being his second season with this form of igniter, and he reports excellent success with it.

If around the spark coil employed in primary ignition and on the outside of the coarse wire winding there

be wound another coil of very much finer wire, the rapid change in the intensity of the magnetic field caused by a break in the primary circuit will also induce an impulse in the fine wire winding corresponding to that which makes the spark in the primary igniter. Owing to the very great number of turns of the fine wire, the pressure of this impulse is very great, while the intensity of the current is very small. The high voltage or pressure of this fine or secondary winding is sufficient to overcome the resistance of an air gap, over which it will cause the current to pass, making a spark as it does so. The pressure derived may be better realized when it is known that a pressure of about 20,000 volts is needed to cross an ordinary air gap of about one inch. Jump-spark coils for gas engines are usually made so that they have sufficient voltage in the secondary to spark across a gap of from a half inch to one inch. The normal sparking distance for the engine, however, is about 1-32 inch.

In Fig. 17 are illustrated the circuits for a jump-spark system of ignition. The Ruhmkorff or, as it is generally called, "jump-spark" coil is shown at the left of the figure. As with the coil shown in Fig. 13, it has a soft iron core *a*, about which is wound the primary winding *p*, through which the current flows from the battery of cells *c*, *c*, and around this coil is wound a secondary of fine wire *s*. The primary circuit is broken at the proper time in the circuit by means of the cam *k*, having a notch, as shown, into which the knob *g* is forced by the spring *h*, allowing the platinum points *n* to come together, closing the circuit through the coil *p*. The usual form of jump-spark coil is provided with a magnetic vibrator in circuit with the primary. This vibrator consists of an iron armature *j*, mounted on a brass spring *i*, which is attracted by the core *a* as soon as it is magnetized, and, drawing *j* toward it, breaks the circuit at *f*; when *j* is released the circuit is closed, and the former operation is repeated just as in a vibrator on an electric bell. This vibration sets up a series of magnetic oscillations in the core *a* and increases the effect on the secondary circuit, making a more intense spark than would be produced by a single break in the primary.

The terminals of the secondary are, one of them, grounded on the engine and the other connected to a highly insulated electrode *e*. This electrode is held in a plug *m*, which is screwed into an opening into the combustion space of the engine. Riveted into the edge of the plug is a bent platinum wire *w*, which is curved toward the central electrode *e* so that there is a gap of 1-32 inch between them. The terminal *w* is in circuit with one end of the secondary winding through the wall *m* of the plug and the grounded wire. When the circuit is closed at *m* a series of sparks are produced at the gap of the plug, which continue until the points *n* are separated. As in the circuit shown in Fig. 13, the tendency is to produce a very hot spark at both *f* and *n*, and in order to reduce this spark an electric condenser *x* is connected across the gap *f*. The condenser consists of layers of tinfoil, between which are placed sheets of oiled paper. There is no metallic contact between the layers of tinfoil, which are connected to the opposite sides of the circuit, but the condenser absorbs a portion of the impulse produced by the break and reduces the volume of the spark, thereby increasing the life of the platinum points.

Ordinarily the coil described will not give a sufficient spark for ignition with a single break in the primary, but by the use of a special winding the vibrator may be dispensed with, and an igniting spark will be given at the plug each time that a circuit is made and broken through the primary at the points *n*. With this form of coil the cam *k* should be so set that the points *n* *separate* just at the time a spark is necessary at the plug.

The points *n* and the spring *h* are attached to a block of fiber *d*, which may be rotated around the cam *k*, changing the time in which ignition takes place. Rotating *d* in the same direction as *k* rotates retards the ignition, and *vice versa*. This method of changing the lead of the ignition is very convenient, and the fact that there are no moving parts of the igniter in the cylinder or attached to heated portions of the engine are points in favor of the jump spark. For multiple-cylinder engines two methods are employed, the most usual one being to make the number of coils and the number of pairs of contacts *n* equal to the number of cylinders. The latest practice, however, is to use one coil and to commute the secondary current so that it is in circuit with but one plug at a time. In this case the cam *k* has a number of notches equal to the number of cylinders.

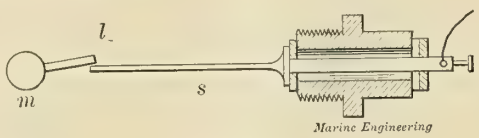


FIG. 16.

In addition to the troubles experienced with the primary igniter, the jump spark has troubles peculiarly its own. The high pressure of the secondary circuit requires high insulation to keep it within proper bounds, and it is customary to cover all the secondary wires with rubber tubing. Carbon is apt to bridge across the terminals of the plug, causing it to short-circuit, so that no spark is formed; the insulation of the plug will sometimes break down, or the plug may be short-circuited itself by moisture either in the insulation or on its external surface. A moist plug may be dried most rapidly by dipping it in gasoline and setting fire to it, of course the plug being removed from the cylinder for this operation. Deposits of carbon are due to excessive lubrication, which should be avoided. However, a plug that is inserted directly in the path of the incoming gases is less inclined to foul than if placed anywhere else. Another scheme to avoid the carbon bridge is to insert the plug at the end of a nipple about half an inch long, thus placing it in a small pocket. This latter scheme was recommended to the writer by an experienced automobile operator, but he must admit that he has given it no trial himself, and so cannot say whether it will dampen the spark or not. The user of the jump spark should watch his plugs carefully and clean the points frequently. He should also watch the contacts *f* and *n*, see that they are always bright and make good contact. The spring *i* should never be allowed to

hammer against the end of the core *a*, but the contact screw should be so adjusted that *i* will move freely, as close to *a* as practicable without touching it.

Current is supplied to both forms of electric igniters by means of either a dynamo or one of various forms of batteries. The dynamos are of various kinds, some of them with permanent magnets and of the variety known as magnetos, while others have electromagnets for their fields, excited by their own current and called self-excited machines. In the later forms of these machines they are supplied with an automatic governor, which keeps them from running above a certain speed, as high speed both increases the wear and raises the electrical pressure. Quite often these dynamos are used in conjunction with a storage battery, the battery being used to start the engine and as a reserve in case the dynamo goes wrong. The battery is so arranged that it can be charged by the dynamo at the same time it is furnishing current for the igniter. Sometimes a battery of storage cells is used alone and, as it runs down, charged occasionally from an external source.

Many forms of primary cell are used, a great many of these being of the zinc and copper-oxide type, in which the fluid, known as the electrolyte, is a solution of either caustic potash or caustic soda, most generally the latter. The ordinary bell "battery," with terminals of carbon and zinc and a solution of sal-ammoniac for the electrolyte, will, as ordinarily made, not give good satisfaction for gas-engine igniters. However, some of the latest forms of this cell are so constructed as to adapt them for gas-engine use, and in the "dry" form they are quite convenient for boat use. The reader is advised to make sure that he gets the form of cell which is made expressly for a gas-engine igniter. Four sal-ammoniac cells or five cells of the caustic-soda type are sufficient for operating an igniter of either the primary or the jump-spark type. Two batteries of a suitable number of cells each should be installed in a boat, with a switch so wired to them that either one or the other may be thrown in at the will of the operator, for a battery is apt to give out unexpectedly and at any moment. The launchman should always take with him on a trip spare igniter parts, particularly springs and electrodes, or, if he uses a jump-spark igniter, he should invariably have a full set of spare plugs, and it is also a good plan to have a spare coil if a long trip is contemplated. In connecting up a primary igniter for a multiple-cylinder engine, it is considered the best practice to use a separate battery and a separate spark coil for each cylinder of the engine, although the writer's experience indicates that it is sufficient to provide a battery for each two cylinders and a spark coil for each one.

(To be continued.)

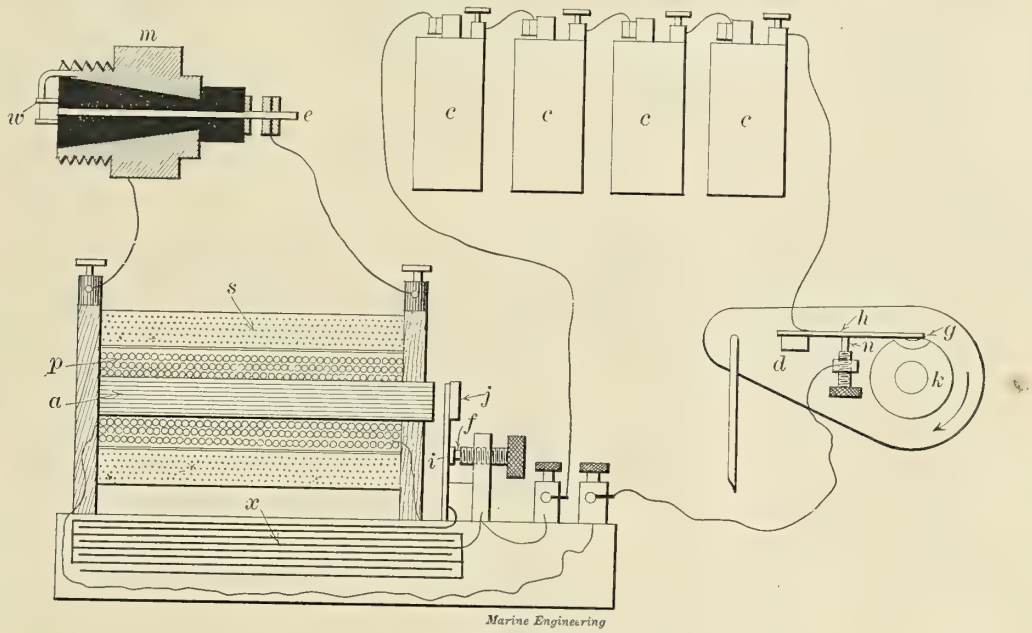
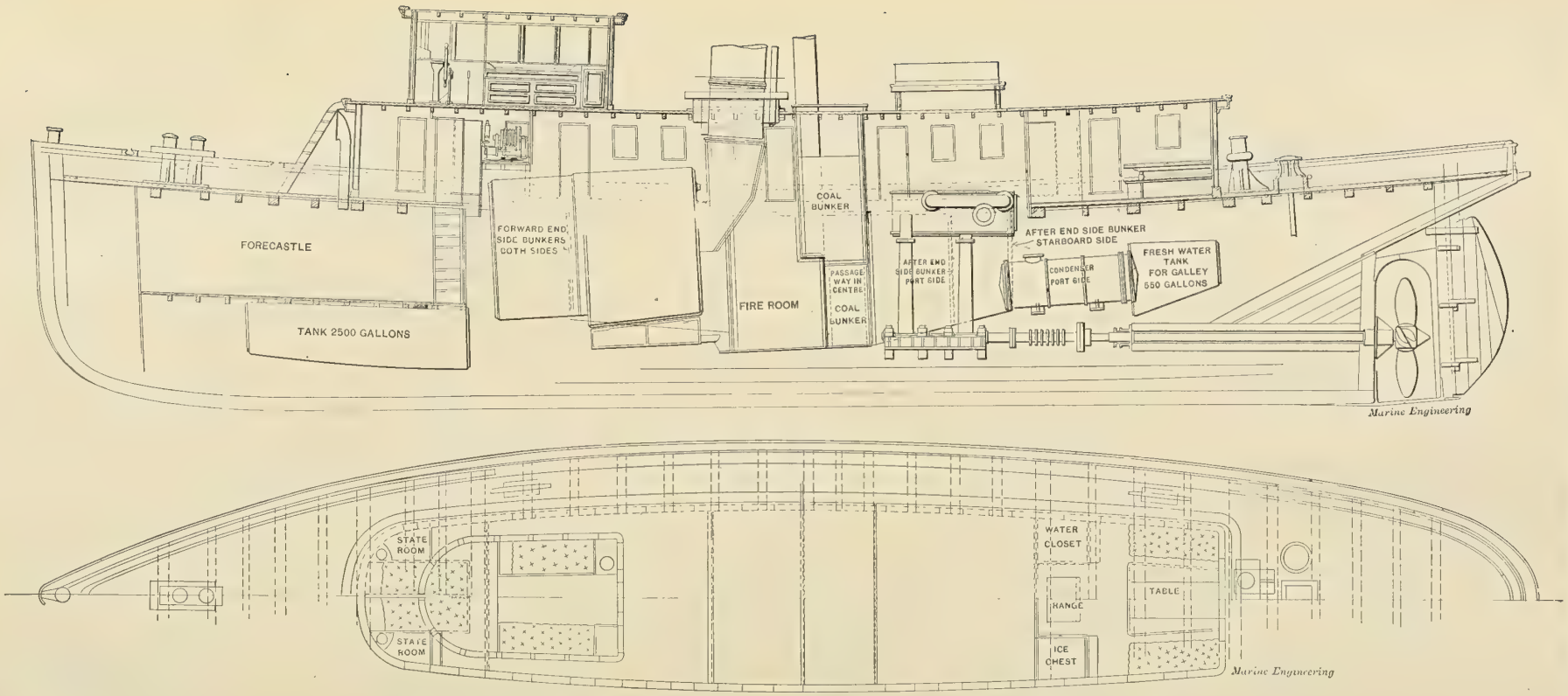


FIG. 17.

Bermuda Dry-dock.—The new Bermuda dry-dock, built by Swan and Hunter at Wallsend-on-Tyne, has been towed to its station in Bermuda. Before leaving the other side, for the purpose of testing this dock, the British battleship *Sans Pareil* was docked by it.

United States Shipbuilding Company.—Through the Trust Company of the Republic of New York, $9,000,000 first mortgage, thirty year, 5 per cent. bonds have been subscribed for the United States Shipbuilding Company. The following plants have been acquired by this company: The Union Iron Works, San Francisco, Cal.; The Bath Iron Works, Ltd., and the Hyde Windlass Company, Bath, Me.; The Crescent Shipyard and the Samuel I. Moore Sons' Company, Elizabethport, N. J.; Eastern Shipbuilding Company, New London, Conn.; The Harlan and Hollingsworth Company, Wilmington, Del.; and the Canada Manufacturing Company, Carteret, N. J. These plants have been appraised at about $20,000,000, and have at present under construction work amounting to about $36,000,000. The bonds above referred to are a part of an issue of $16,000,000, for which $5,500,000 are withdrawn from public issue, to provide cash working capital for the company.



LONGITUDINAL SECTION AND PROFILE OF TUGBOAT JOHN G. CHANDLER, DESIGNED BY MESSRS. KEOUGH.

NEW BOSTON TUGBOAT.

A vessel whose appearance in Boston waters is looked forward to with much interest is the new tug *John G. Chandler,* now building for the Commercial Towboat Company, by Kelley and Spear and the Bath Iron Works of Bath, Maine, from the designs of Richard F. and William T. Keough, of East Boston.

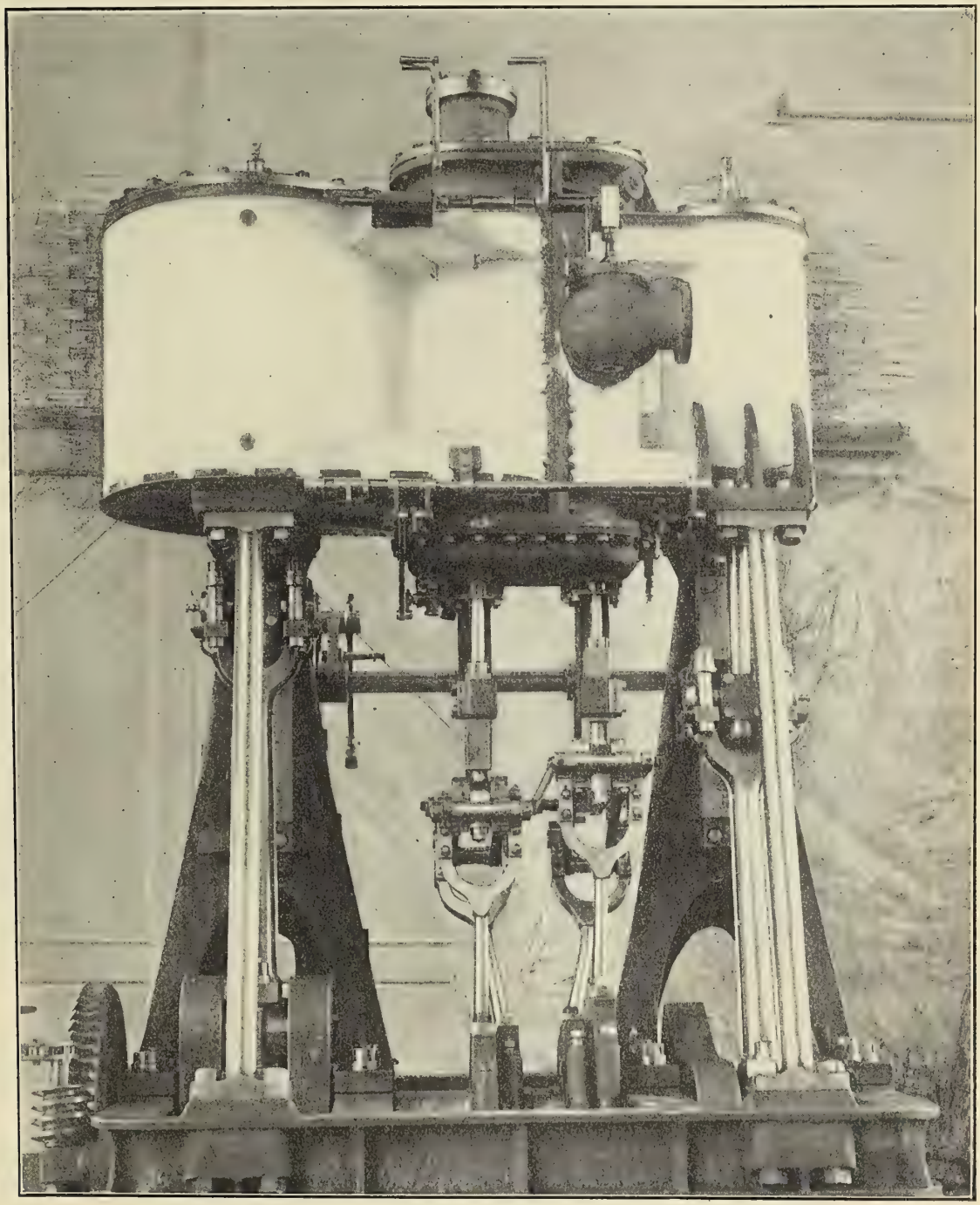
With the increase in size of coal barges and five-and-six-masted schooners has come a demand for harbor tugs of suitable size and power to tow them up from the bay and place them in their berths at the coal wharves. The need of tugs of this type is illustrated when one of the six-masted schooners, like the *Eleanor S. Percy,* sometimes requires four or five tugs of the old-fashioned type to place her in her berth.

The new tug is built of wood; the stem, keel, stern post, and outboard planking being of white oak, the frames of white oak and hackmatack, the ceiling and beams of yellow pine, and the deck and deck houses of white pine. There is a very large forecastle, in which are the quarters for the crew, and abaft the machinery is a very roomy lazarette for the stowage of hawsers, equipment, etc. A large and roomy deck house is fitted, in the forward end of which are two state rooms for the officers. Next in order come a steam steerer room, boiler room, engine room, galley, and mess room. In the after end of the pilot house is a large state room for the captain. There will be two metallic lifeboats and all the equipment and outfit of the most complete modern tug.

The machinery is to be of the most modern design and construction. The main engines are of the vertical inverted compound type with independent pumps. The air pump is to be of the vertical twin type, the circulating pump of the centrifugal type, and the main feed, auxiliary feed, bilge, sanitary, and boiler circulat-

ing pumps are all of the vertical duplex type. An inspirator and an ejector will also be fitted, and there will be a steam steerer and a steam hawser engine.

The boiler is of the firebox flue and return tubular type, built for a working pressure of 125 pounds per square inch. The front connection is outside the boiler and connects with a single smokestack 30 feet high above the upper deck. The tanks and coal bunkers are both built of steel, the former with a capacity of 3,500 gallons of water, and the latter 40 tons of coal.

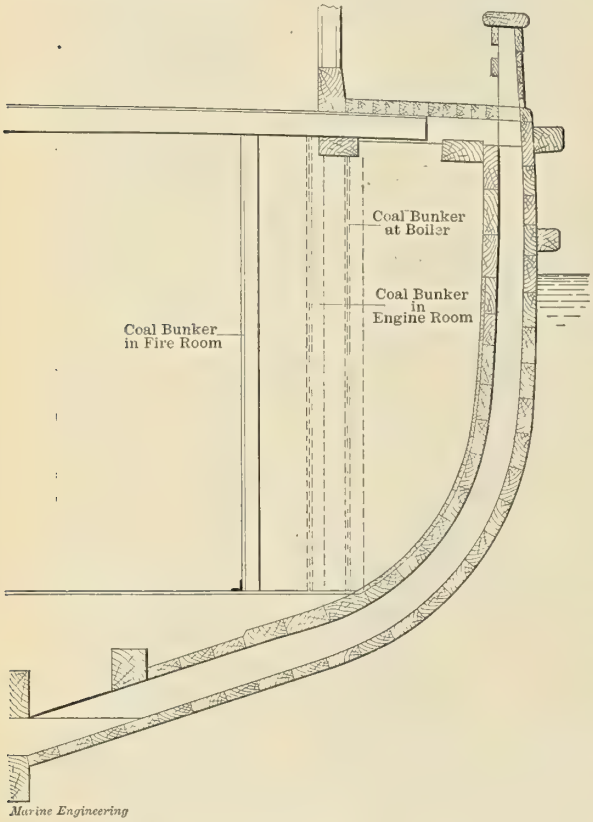


COMPOUND ENGINE BUILT BY THE BATH IRON WORKS FOR THE TUGBOAT JOHN G. CHANDLER.

It will be seen from the description that the new boat is much larger and more powerful than any of our harbor boats; but by means of the use of steam for steering, it is expected that she will be able to do all that is required of a boat of that class. In addition to her usefulness as a harbor tug, she is of sufficient power and coal capacity to hold her own with almost any of the ocean-going tugs hailing from the port in towing barges to and from the coal ports. Heretofore the ocean-going tug has been found too long for satisfactory service in harbor work, and the harbor tug has lacked power and coal endurance for coastwise work. This

is the first attempt in this vicinity to combine the two types in one, and the result is awaited with much interest.

The principal dimensions are:
Length over all, 102 feet.
Beam, over plank, 20 feet.
Draft, loaded, 11 feet 4 inches.
Engines, number, 1.
Type, compound condensing.
Cylinders, diameter, 15, 34 inches.
Stroke, 22 inches.
Length of engine room, 11 feet.
Boilers, number, 1 firebox flue and return tubular.
Diameter, 9 feet 6 inches.
Length, 14 feet.
Condensing surface, 800 square feet.
Propeller diameter, 8 feet.
Pitch, 10 feet 6 inches.



MIDSHIP SECTION OF THE JOHN G. CHANDLER.

By an ingenious distribution of the weights the designers have succeeded in arranging to have the draft remain practically at a maximum throughout the coal endurance of the boat, the importance of which every experienced towboat man will appreciate.

Both boiler and engines were made by the Bath Iron Works, Bath, Me.

Oil Steamers.—There was recently launched at Newcastle-on-Tyne an oil carrier named the *Pure Oil* and built for the Pure Oil Company of Philadelphia. The vessel has a carrying capacity of 6,000 tons and is for the transatlantic trade.

New Rules of the United States Standard Register of Shipping.

Rules for classifying wooden or steel vessels in the United States Standard Register of Shipping, New York city, have just been published and are in many ways a decided improvement over the previous rules of this association, as they have been extensively revised and enlarged to meet the demands of the present large shipbuilding practice.

The work of building a vessel according to any set of rules is in itself sufficiently tedious because of excessive proportions or from the fact that it may be built for especial service. It has evidently been the object of the compilers of the new rules to tabulate wherever possible scantlings covering all requirements, and, therefore, a most comprehensive set of tables is given, while the reading matter is so subdivided that the clauses governing special cases may be readily found.

Sections covering the classification and survey of vessels are practically the same as in the previous rules. The classification of vessels intended for sound, bay, and inland navigation will be especially considered. The paragraph on keels has been improved by dividing into six subheadings—Bar, Through Plate, Flat Plate, Continuous Center Line, Intercostal Center Line, and Center Line Single Plate Keel standing on the top of the floors. An improvement is also found in the paragraph on Stem and Stern Posts, a subheading being also given for Propeller Posts. The riveting for all members is tabulated under exhaustive tables, where will be found the diameters of rivets and spacing in inches for all classes of riveting in hull construction.

The paragraphs on Frames, Reverse Frames, and Floor Plates have been rewritten, and in the latter is a paragraph concerning the thickness of flange plates where used for floors. To meet the requirements of modern construction, the rules governing keelsons and stringers have been entirely recast and divided under the headings, Side Stringers, in connection with ordinary framing, in connection with web frames, and in connection with deep frames. Under Hold Beams and Stringers are given the rules for wide-spaced beams, and the depth of these beams for different size vessels is also stated. The subjects of Web Frames, Bulkheads, and Hatchways are also dealt with in a clear and concise manner. Owing to the new type of rudder generally adopted since the last set of rules appeared, the rules governing this member are new.

As previously stated, wherever possible reference is made to complete tables, which form a most valuable part of this book. In table 1 are given the scantlings, according to the tonnage by rule, of keels, stem and stern posts. It should be noted that, owing to the improvement of material, some of the scantlings have been cut down. Table 2 contains the scantlings of frames and floors; table 3 the shell plating, which is practically the same; in table 4 are given the dimensions of beams, of angle and channel section when supported by one, two, and three rows of stanchions; and in table 4A is given a list of equivalent beams.

In table 7 dimensions of the various members of the center keelson are given for the length of ships up to 620 feet. In table 8 are given the dimensions of bilge

and side keelsons and side stringers. Stringers for various lengths and breadths are given in the very complete table No. 9, which occupies no less than eight pages.

As previously stated, the dimensions for all kinds and sizes of riveting are reduced from rule to an elaborate table. The spacing of the rivets for the various kinds of laps and straps is given in inches for each thickness of plate, also the riveting for butts and the breadth of straps and laps. Table 11 contains the scantlings of the double bottom, and in No. 12 are given the dimensions for anchors and chains.

The succeeding pages of the book are devoted to sections of special types of vessels not covered by the rules, and indicating the construction acceptable for classification, and the remainder of the book is devoted to a register of United States shipping. By using this book in getting out the scantlings of vessels, it will be found that the work will be much simplified, as the rules have evidently been prepared by men acquainted with the requirements and the art of shipbuilding.

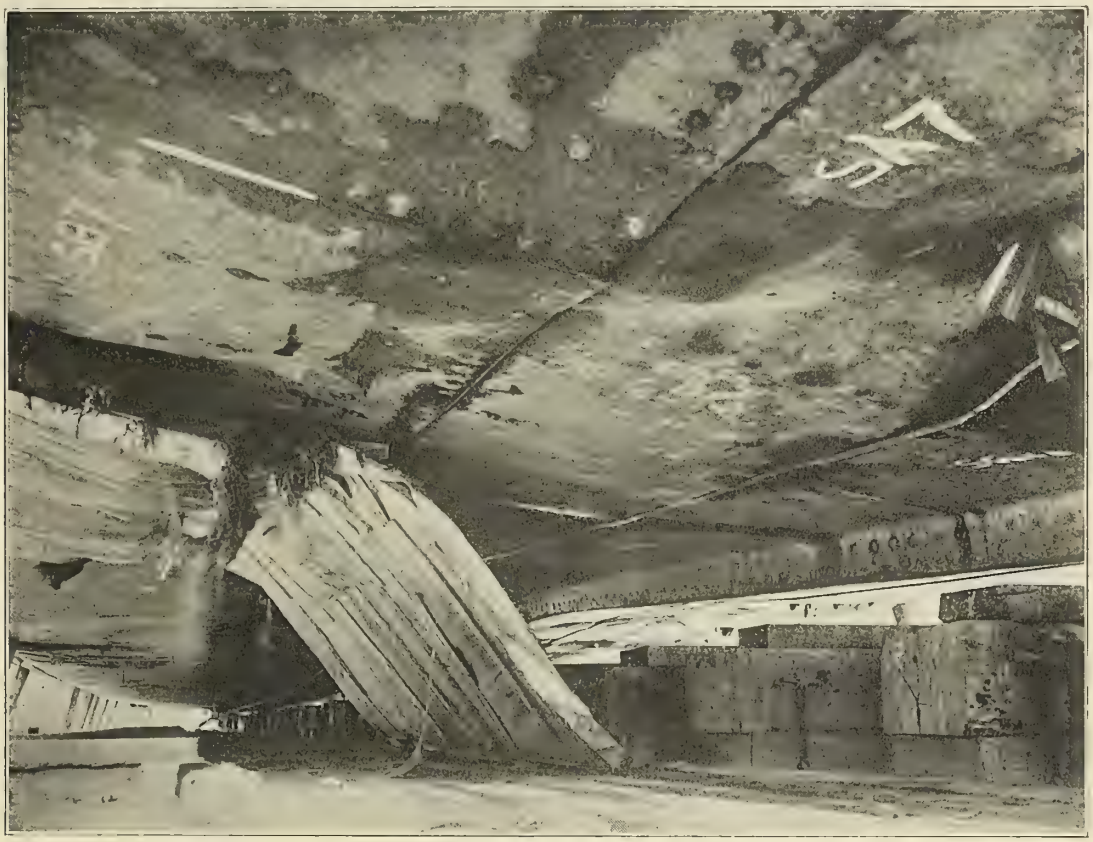
New Battleships.—Secretary Moody has selected the New York Navy Yard as the one in which to build one of the first-class battleships provided for in the last naval bill. It is decided that the $175,000 appropriated by Congress for preparing a navy yard to carry out large Government work could best be utilized in the New York yard.

Salving the Indian.

Editor of Marine Engineering:

I am sending you a few views of the wreck of the S. S. *Indian* on Sow and Pigs ledge. She came on there in a thick fog on March 29, 1902, and, as there was a heavy swell at the time, her bottom was soon full of holes and the ship full of water. The life-saving crew of the island took the passengers and crew off, after lying by her a long while waiting for a chance to get alongside.

The Boston Towboat Company took the job of floating her, and took out as much of her general cargo as possible, sent divers down and fixed what holes in her bottom that they could get at, and then put on board ten steam pumps and tried to pump her out; but it was of no use, for her entire bottom was full of big holes. They then went to work and boarded up the hatches of the lower deck, the divers taking down one plank at a time and putting it under the combings of the hatch. This was a long job, for when it got rough outside the swell inside would wash the plank away, which shows in what condition her bottom was. They finally got the plank all under and fastened; then they weighted the regular hatches with pig iron and put them on; and covered the whole with heavy canvas, and boarded that over. Stanchions of 6 by 6 inches yellow pine were then put in all around the hatches and all over between decks. They then went to work with their ten steam pumps and pumped the water out down to that deck and pulled her off the rocks. A good many people



BOTTOM OF THE STEAMER INDIAN, SHOWING SOME OF THE DAMAGED PLATES.

thought the deck would burst and let her sink, but it held, and she was towed to Vineyard Haven for further repairs. The work on her took just seven weeks, with three tugs and two lighters in attendance. This is the first steamer ever floated off Sow and Pigs ledge, although many have gone on there.

W. A. Charles.

THE STEAMER INDIAN, ASHORE OFF THE MASSACHUSETTS COAST.

ton Dry-Dock and found that 170 plates were damaged, the frames and floors for practically the entire length of the ship were broken and damaged, the stern frame bent, propeller gone, and the cabins and decorations were more or less damaged. The machinery will have to be thoroughly overhauled, although it is not seriously injured.

LIGHTERING THE CARGO OF THE INDIAN.

The contract for repairing the *Indian* was awarded the Erie Basin Dry-Dock Company, New York, whose bid was $30,000, the repairs to be completed in thirty-one days.

A Board of Surveyors inspected the ship at the Bos-

New Ferryboats.—Two new ferryboats are to be built by John Dickie and Company, of San Francisco, for the Southern Pacific service on San Francisco bay. The boats will have three decks and will cost about $175,000 each.

MODERN SHIPWAY EQUIPMENT, AND ITS FUTURE DEVELOPMENT.—II.*

BY TJARD SCHWARZ.

Again, if the boom is arranged to give a variable reach, much complication is added to the operating mechanism. Further, the foundation and the balancing of the crane for stability both present difficult problems, and the reach is thereby somewhat restricted, as well as movement relative to the dock front. The 100-ton derrick crane of Blohm and Voss in Hamburg, designed and constructed by the Duisburger Company, shows improvements in these directions, inasmuch as the reach may be increased up to 100 feet, while due regard has been paid to the movement relative to the wharf. A crane designed and constructed by the Harkort Company in Duisburg is provided with two separate sets of hoisting gear, for loads of 100 tons and 30 tons respectively. Further, each gear is arranged with two speeds, giving the following values:

HEAVY GEAR.

Loads up to 50 tons	8.5	ft. per mt.
Loads 50 to 100 tons	4.25	" "

LIGHT GEAR.

Loads up to 10 tons	40	ft. per mt.
Loads 10 to 30 tons	13	" "

Both hoisting gears are operated by a two-cylinder steam engine of 9 1-2 inches diameter and 18 inches stroke, making 180 revolutions per minute.

In order to obtain the highest possible efficiency of operation the use of worm gearing and bevel gears has been avoided, and only cut spur gearing has been employed in the apparatus. Furthermore, all parts of the hoisting gear direct are made of special size and strength. In both gears a single lead of the steel rope has a guaranteed strength of 100 tons, while in the large gear the load is carried by eight such and in the two small by four. In both gears the turning parts are carried in ball bearings, and all movements are thus readily executed.

The reach of the crane is under the control of the operator and may be varied between the following limits: For the large gear, between 56 feet and 94 feet; for the small gear, between 59 feet and 107 feet. In this connection it should be remarked that the small gear is capable of carrying a load of 30 tons at its maximum reach, while for the large gear the maximum load of 100 tons is not intended to be carried beyond a reach of 65 feet. If, then, it is remembered that the pivoting center of the crane is only 8 feet from the edge of the dock, it follows that the maximum reach of the crane is $107 - 8 = 99$ feet.

The boom has the form shown in the figure. Movement is given to the boom by a second steam engine of 8 1-4 inches diameter of cylinder and 12 inches stroke, which may also, if need arise, be coupled to the hoisting gear. For bringing about the variation in the reach use is made of two screws of Siemens-Martin steel. The pitch of the thread is such that the boom loaded may be safely left at any position desired. In addition to this a self-working brake is attached in such manner as to provide against any undesired movement which might arise due to jar, etc.

*Translated and abstracted for Marine Engineering from the *Jahrbuch dee Schiffbautechnischen Gesellschaft*, 1901.

The horizontal forces in the boom are carried in a simple manner by the steel pins, as shown in the cut. The severe conditions to be fulfilled imposed upon the designer the need of making special provision for carrying the vertical load. The enormous weight to be carried and the restricted ground area, about 14.5 feet in diameter, forbade the use of the usual ball or roller form of support. For these reasons a form of circular track was selected. Through the choice of suitable materials with special means for lubrication, in connection with the greatest possible care in construction, the design has been highly successful, and the actual loss through friction has been less than as indicated in the preliminary computations. The turning speed of the boom, measured at the small hoist with its greatest reach, is 100 feet per minute with 180 revolutions per minute of the turning engine.

For bringing steam to the steam engines a special boiler is not necessary, as the boiler house of the Blohm and Voss yard is situated near the crane. The common pipe for both engines is carried through a stuffing box in the geometrical axis of the boom, and delivers steam of 60 to 90 pounds pressure. The crane as a whole is operated by one mechanic, who is placed in the forward part of the boom and at an altitude of about 23 feet, from which place the field of operation of both hoists may be plainly seen. Furthermore, as a protection against storm, the steam engines, the operating mechanism, and the stand of the operator are covered with an iron protective house. This is roomy and well provided with numerous windows.

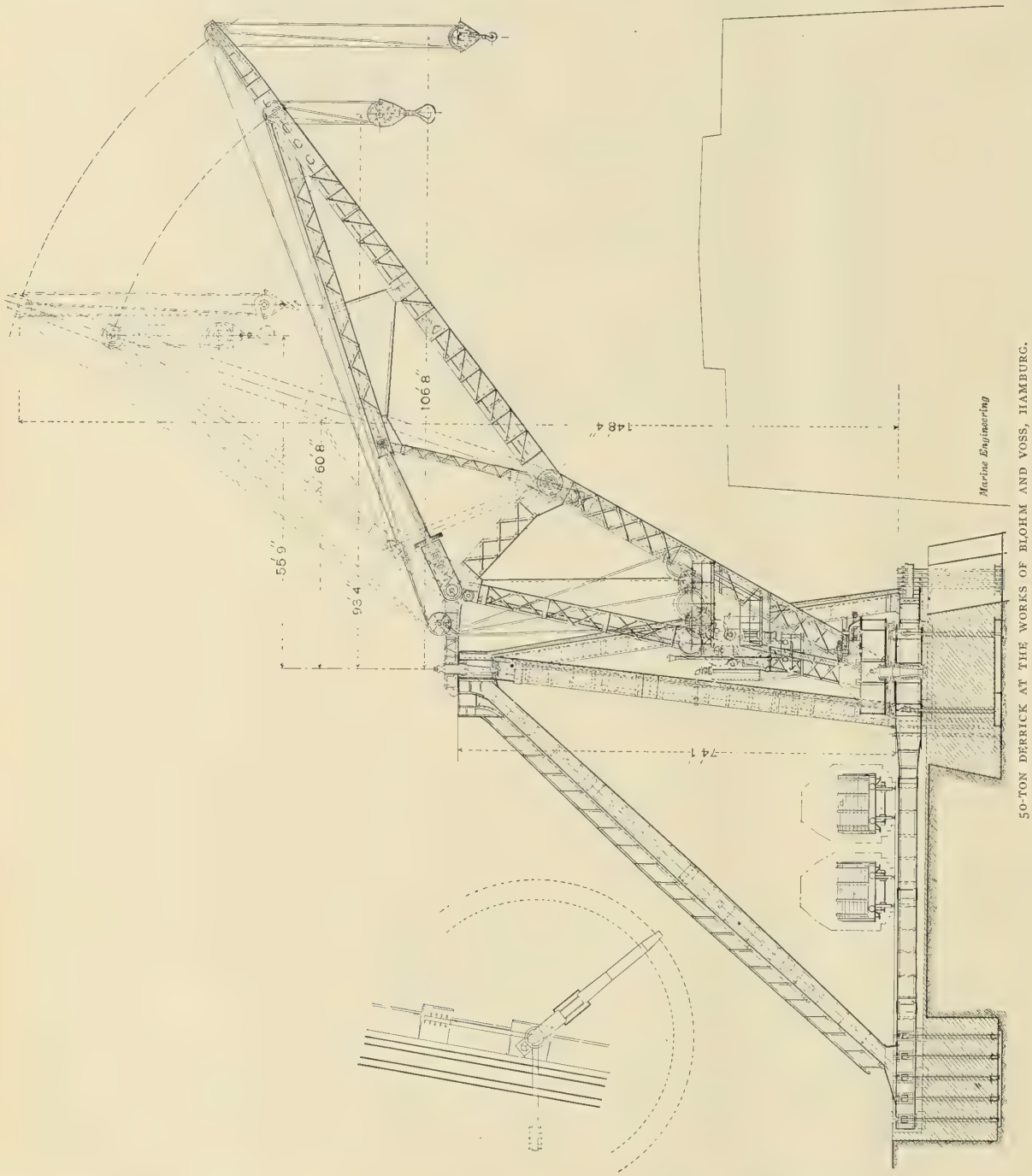
For the turning support of the crane the box-like connections of the foundation form an extraordinarily strong construction, and it is especially noteworthy that the demands in connection with the three foundations are most satisfactorily met. The middle foundation block under the boom experiences only a vertical load, and the two others, according to the position of the boom, experience only a vertical pressure or operate as a counterweight for the load. The crane has been since October 27, 1897, in uninterrupted use, and has given the most complete satisfaction to its owner.

An entirely new and peculiar construction is found in a crane erected at the Kaiser Dock in Bremerhaven by the Benrather Company. This crane is of 150 tons capacity and seems to avoid the difficulties met with in previous types in a most efficient manner. The crane consists essentially of a stationary tower built of structural steel, within which a crane pillar is carried, with bearings at the foundation and at the top of the tower. At the top this pillar is connected to two symmetrical booms of girder construction. Upon one of these the operating trolley moves back and forth, while upon the other a balance weight is fitted in such manner as to insure stability whether the hoist has its full load or hangs free. As the crane pillar turns through 360 degrees, while at the same time the trolley may be operated in and out, the entire annular area between two radii of 72 feet outer and 26 feet inner radius may in this manner be readily served by the crane. Furthermore, as the crane is securely balanced, and especially against wind pressure, and the trolley moves only in a horizontal direction, it follows that the operation of the crane requires the minimum expense of work. The

hoisting gear consists of suitable sheaves through which is rove a wire cable of about 2.4 inches diameter. The blocks are provided with seven sheaves, thus giving a sufficient number of sections of the rope to insure a large margin of safety.

The operation of the crane is brought about by means of direct-current motors under control from an operating house suitably situated. For hoisting the weight two motors are provided, aggregating 40 H. P. For turning the crane, as well as for operating the trolley, a single motor of 25 H. P. is employed. For holding the weight fast two self-operating mechanical brakes are provided, as well as an electrical brake which is put into operation automatically upon the stopping of the motors. Under varying conditions the hoisting speed may be varied as follows:

150	tons	load	2.25	ft. per mt.
75	"	"	4.25	" " "
37	"	"	10.	" " "
18	"	"	20.	" " "



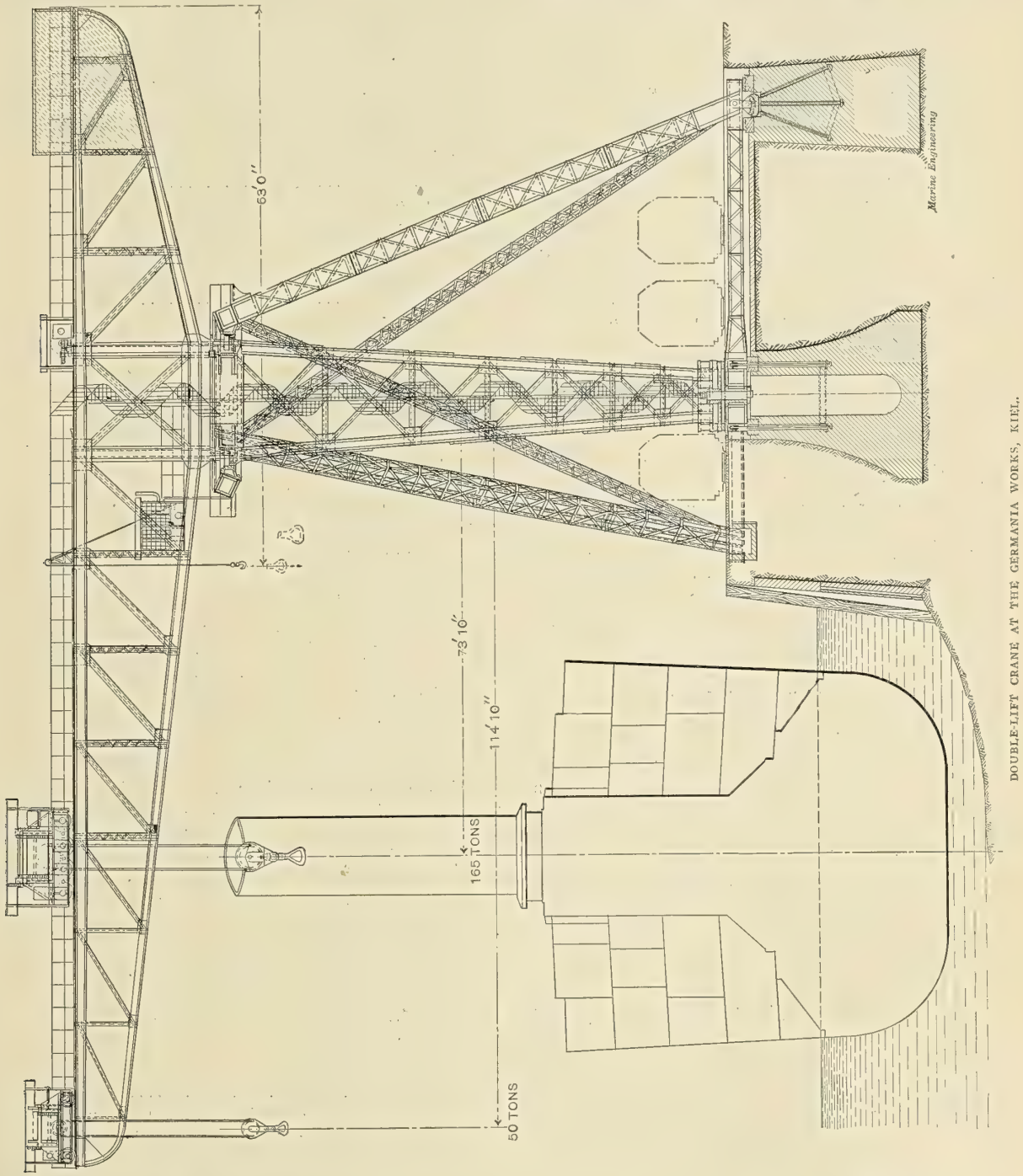
50-TON DERRICK AT THE WORKS OF BLOHM AND VOSS, HAMBURG.

The trolley may be operated at a speed of 25 feet per minute, while the entire crane in 7 minutes may be turned through one complete revolution.

The service of the crane is centered in the operating house, which is placed on the side of the boom. There are here mounted a double controller for hoisting and

turning and a single controller for the travel of the trolley. As the only objection against this crane it is to be noted that the boom must be placed at a sufficient height to clear the funnel and deck erections on the ship, while with masts in place its movement must necessarily be somewhat hindered.

The circle swung by the hoisting gear at its outer reach and with 45 tons load has a radius of 115 feet, while with a load of 150 tons the corresponding radius is 75 feet. The feet of the girder supports are carried on especially prepared foundations, one in the middle for the main support and three outer ones for the three



DOUBLE-LIFT CRANE AT THE GERMANIA WORKS, KIEL.

In accordance with the same general requirements the Duisburger Company has in construction for the Germania Company a crane shown on this page. The supporting construction is of girder form and is given a somewhat greater area of support, while the movement relative to the dock is somewhat less limited. supporting struts. The lower ends of these girder supports are tied together under the dock level, as well as to the middle foundation, with a connected construction, so that the outer three foundation blocks, of which two lie at the dock edge, only receive vertical pressure. The horizontal forces developed by the boom

are carried to the middle foundation block through a suitably arranged pivot.

The support of the vertical load on the middle foundation block is provided by a roller bearing. This contains 32 turned steel rolls 8 inches wide which run upon a track of forged steel. This track, with the rollers, is protected against dust and dampness by suitable oiling arrangements.

The support of the girder struts is united at the top by a ring of box form cross-section. On the inner side of this are the roller track and the axle of cast steel secured with steel bolts. The boom is supported against the rolling track on both sides by the help of four cast-steel rollers of 30 inches diameter and 8 inches breadth. These are arranged so as to give an adequate vertical support to the boom and so as to provide for adjustment in case of wear of either rollers or track. A pair of toothed wheels are connected to the driving axle from the turning gear, and the latter is operated by the motor on the upper side of the boom.

The support of the forces which are developed on the axle in turning is carried to the foundation through the girder support. To this end the members of the latter are provided with strong diagonal ties, so that both ties and struts are available for suitably carrying the forces developed.

In order to move the enormous weights and to provide for the possible wind pressure, the driving mechanism for turning the crane is made especially strong, so that no deterioration in any appreciable time is likely to be of importance. In order to assist in balancing the wind pressure with reference to a turning movement, the balance weight of the boom is given a corresponding surface exposed to the wind.

The boom itself consists of two continuous built-up girders, upon the dock end of which travel the two trolleys, while the other end serves to carry the balance weight. The arrangements in general are such as to provide a suitably broad track for the trolley, together with ample support for the load to be carried. In order to reach the boom from the ground a winding staircase is fitted in the main pillar. On the dock side of the boom the operating house is located where it may be easily reached by a covered passage from the top of the winding stair. This house is of sufficient size to contain conveniently all electrical apparatus, tools, a stove, and other necessary equipment. Furthermore, a small electric hoist is installed of about 1 ton capacity in order to serve for hoisting quickly small weights within this limit.

The two trolleys are entirely independent of each other, and each has its own connection with the operating motors. In order to securely hold the load in any position each hoisting mechanism is under control of a safety brake which may be operated either mechanically or electrically, so that any undesired movement of the load is efficiently prevented.

As the weight of the trolleys is considerable, an effort has been made to locate the hoisting gear as much as possible on the back arm of the boom. The hoisting ropes have a factor of safety of 8 to 10 and are carried over proportionately large sheaves. The hooks are mounted so as to turn on ball bearings in any direction which their use may require. For all turning parts, where possible, automatic oiling arrangements are provided. The electrical drive of the entire hoisting gear is arranged by direct-coupled motors, with provision for reversing, for movement in either direction. The various speeds of operation are as follows:

HOISTING SPEED, LARGE GEAR.

Maximum load, 140 tons	4	ft. per mt.
Load 100 tons	5	" "
Load 50 tons	6.5	" "
Clear	13	" "

HOISTING SPEED, SMALL GEAR.

Maximum load, 45 tons	13	ft. per mt.
Load 30 tons	16	" "
Load 15 tons	21	" "
Clear	43	" "

SPEED OF LARGE TROLLEY.

Load of 150 tons	16	ft. per mt.
" 100 "	20	" "
" 50 "	25	" "
Clear	33	" "

SPEED OF SMALL TROLLEY.

Load of 45 tons	50	ft. per mt.
" 30 "	60	" "
" 15 "	22	" "
Clear	100	" "

TURNING SPEED.

Crane fully loaded, measured at the hoist in its farthest reach	100	ft. per mt.
Crane without load, measured at the hoist in its farthest reach	115	ft. per mt.

The electric motors have the following capacities:

Hoisting motor for large trolley	50 H. P.
" " " small "	50 "
Traveling motor for large trolley	12 H. P.
" " " small "	12 "
Motor for turning boom	50 "

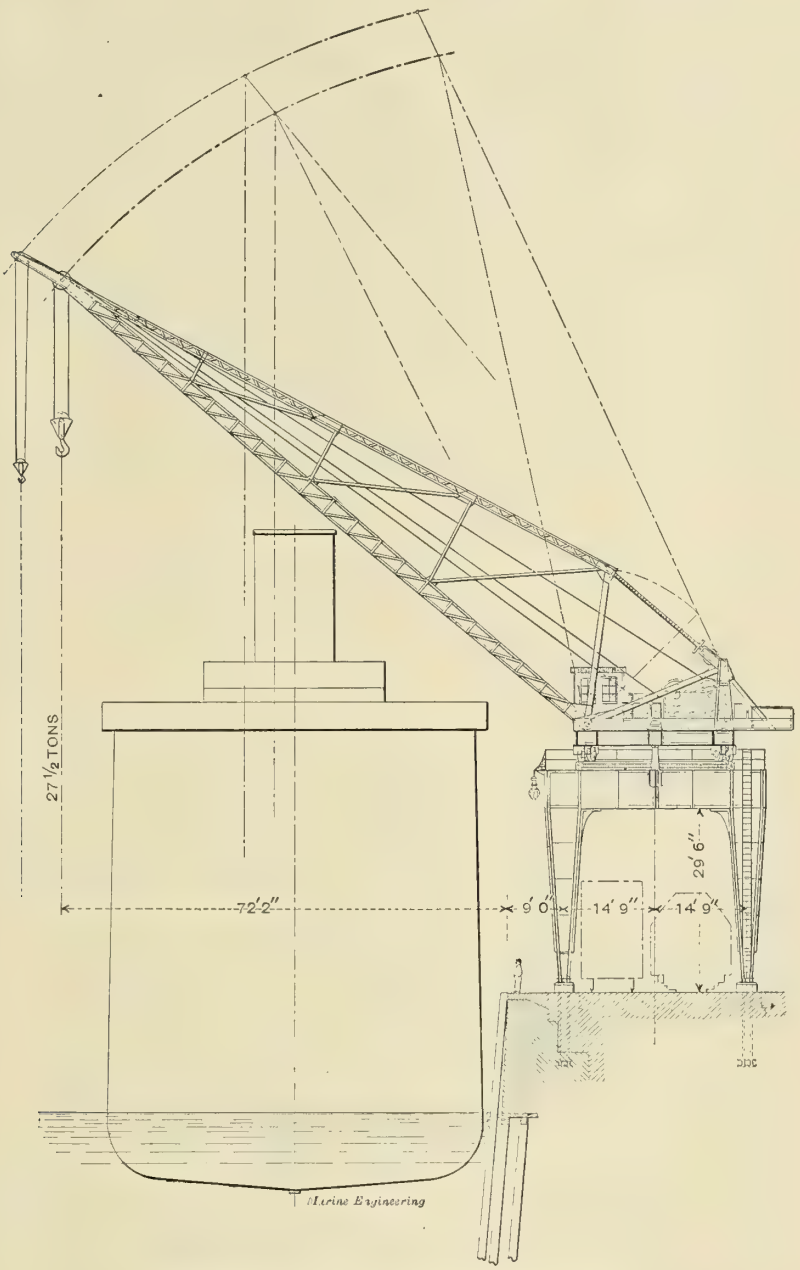
In the case of a similar crane built by the Benrather Company for the Vulcan yard, the capacity was fixed at 100 tons at a reach of 56 feet, or 45.5 tons at a reach of 84 feet. In this crane the girder pillar forms one continuous construction with the horizontal girder boom, and the entire apparatus rests and turns on its own base. The load is thus carried upon 12 trucks, each with 4 wheels. Four of these trucks are driven each by a 12-H. P. electric motor. The centering of the crane is secured through a steel king post in the center of the foundation. The trolley is arranged in the usual manner and is operated by a motor of 12 H. P. The main hoisting gear is provided with two motors, each of 26 H. P. The speeds of operation are as follows:

Hoisting 100 tons	4	ft. per mt.
" 50 "	8	" "
Speed of trolley	26	" "

Turning the crane through 360 degrees..10 minutes.

In addition to these cranes for handling the heaviest weights, there has come into use a further special type of smaller size and with a capacity of 3 to 5 tons. The especial purpose of such cranes is to serve for handling and placing on board the manifold lighter parts of the construction and equipment. Such cranes may also be used for unloading such parts of the material as come to the yard by water transport. They are constructed as traveling and turning cranes with vari-

able reach and great height of hoist. To insure the necessary stability these cranes operate on a track of at least 6.5 feet width. Thus the capacity of such cranes by a widened track may be increased up to 25 tons. In the crane of this character shown in the figure the reach, in the manner indicated, may be varied through a wide range. Such cranes are usually operated by a steam engine provided with steam from a boiler carried the usual style of the shear crane or shear legs, and operated by steam power. The engines for hoisting may also be used for propelling the pontoon by means of two screw propellers connected or disconnected by suitable clutches. In addition the shaft may be provided with a number of warping drums, by means of which the pontoon may be moved about in narrow waterways.



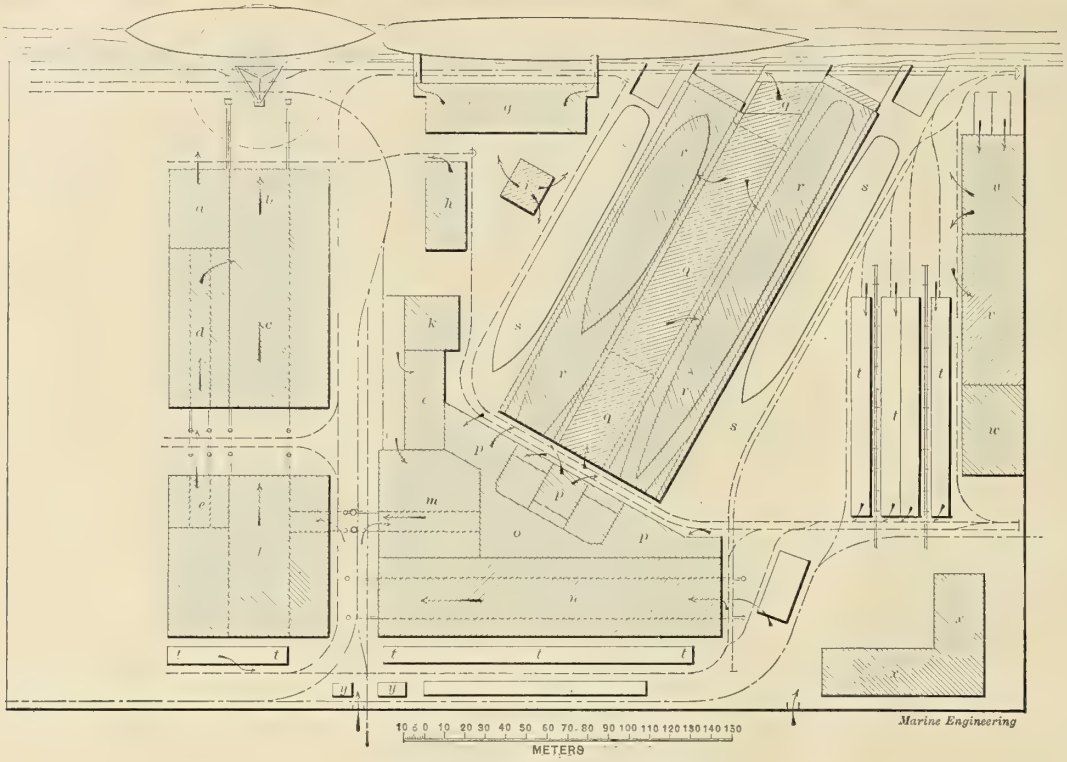
SHEAR-LEG CRANE AT THE WORKS OF BLOHM AND VOSS.

on the crane, and often serving in part as a counterbalance weight.

In connection with the same general line of operation, floating derricks or cranes play an important part, especially in connection with warship construction. They are of especial use in connection with handling heavy armor, guns, anchors, boats, etc. They are built after

The further arrangement for the transport of material about the shipyard, such as locomotive cranes, traveling gantries for the distribution of material at the stock racks, etc., can only be here briefly refered to.

An electric traveling derrick crane has been designed and built by the Benrather Company for general locomotive purposes, and may also be used for moving and



PROPOSED ARRANGEMENT OF A SHIPYARD.

	Area.	Ground Floor.	First Story.	Second Story.
a	12900	Coppersmith Shop.		
b	64600	Erecting Shop.	1-3 Machine Shop.	
c		Machine Shop.		
d	25800	Brass Working Shop.	Brass Working Shop.	
e	8400	Brass Foundry.		
f	60800	Foundry.		
g	21500	Wood Working Machinery and Fitting Shop.	Carpenter Shop.	Carpenter Shop.
h	9500	Store House.	Store House.	Store House.
i	5400	Paint Shop.	Paint Shop.	
k	7800	Power House for Electricity, Hydraulic Power, and Compressed Air.		
l	10700	Boiler House.		
m	27000	Forge Shop.		
n	73200	Boiler Shop.		
o	11300	Ship Forge Shop.		
p	30000	Shop for Working Structural Material Hot.		
q	56500	Shop for Working Structural Material Cold.	Assembling Decks, etc.	Mold Loft Floor.
r	148500	Two Building Docks.		
s		Two Building Slips.		
t	7000	Stock Yard.		
u	16100	Sawmill.		
v	24200	Lumber Yard.		
w	14500	Model Working Shop.	Model Working Shop.	Model Store House.
x	31000	Office.	Office.	Drawing Room.
y	1800	Gateway and Weighing Scales.		

switching railway cars. Each movement of the crane is carried out through a special motor and with the following speeds:

Hoisting ..... 50 ft. per mt.
Turning..... 4 complete turns per mt.
Traveling .....210 ft. per mt.

The motors provided are as follows:

Hoisting .....26 H. P.
Turning ..... 7 "
Traveling ..... 7 "

One point of advantage in this crane consists in the fact that only the crane pillar with the boom turns, while the entire lower structure remains fixed.

And thus I am brought to the conclusion of my considerations, to the development of a design for a shipyard in which there shall be represented, as far as possible, the various methods of transportation and handling previously referred to. The central point of this plant should consist of the two building docks, with two neighboring building slips as shown on the diagram. The two docks should be covered by a single building, while each building slip should be provided with a traveling crane. A peculiar feature may be noted in the location of the cold metal-working shop between the two building docks and covered with a continuation of the same roof which covers the building docks. On the ground floor of this shop, at one end, are located the various tools, punches, shears, etc., while in the middle is a sufficient place for the assembling of armored decks or for the construction of masts, bridges, etc. In the first story is found room for the assembling of decks and like structures. Tools of the lighter class are also located at the side or on the pillars of the building-dock structure. In the second story the mold loft is located, well lighted by windows in the roof. Light is also provided for the lower floors through suitable light shafts. The material, which in the lower floors is transported by the ordinary type of trolley, may be taken direct to the building dock by the aid of the traveling cranes or by use of the tracks at the head of the docks, and the same may be carried to the stationary crane at the fitting-out basin for installation in the ship.

At the head of the building docks are located the various forges, with bending slab and heating furnaces, while joined to the same on one side is found the boiler shop and on the other the central power station. The directions in which the work is carried out in the various shops are indicated on the diagram by arrow heads. On the left side of the yard, and directly in a line back of the large stationary dock crane and beginning from the land side, is located the foundry for iron and brass castings. These are in direct connection with the machine shop by means of tracks, so that the foundry crane may run direct into the machine shop and transport the various castings to the suitable machines without rehandling. On the other side these tracks extend to the water's edge at the stationary crane, so that the various pieces of the machinery, after erection in the shops, may be taken direct to the crane for installation in the ship. The brass foundry is also directly connected by a small traveling crane with the brass shop, next to which, on the water side, the coppersmith's shop is located. At the water's edge is located the carpenter shop, on the ground floor of which are installed the various woodworking tools, and from the second story of which two small crane runways lead to the water's edge. The fittings may thus be taken directly on board ship, and these runways are also made to serve as passageways to the ship by means of a suitable stairway at each end of the carpenter shop. A small traveling crane of 3 to 5 tons capacity, of the Blohm and Voss type, operates between the carpenter shop and the edge of the dock. In order that this crane may pass through the lower construction of the large stationary crane, as well as under the gangways leading from the carpenter shop, the boom may be suitably lowered. In the wake of the building docks and building slips this crane travels over bridges which, on the occasion of a launch or exit of a ship from the dock, may be lifted out of the way by a floating crane. This crane may also be utilized for unloading vessels at the water front and for bringing timber to the carpenter shop. The principal place for stacking material is served by a traveling crane, while for the other secondary locations small electric traveling cranes are sufficient. The arrangement of tracks is shown on the diagram, the dot-dash indication showing the arrangement of standard-gage tracks, while the lines made up of dashes show the arrangement of narrow-gage tracks. The open space on the left of the plan is reserved for a dry-dock. Should it seem preferable to build a floating dock a location for the same may be found in a canal lying at 45 degrees to the dock edge, in such manner that access may be obtained through the space lying between the foundry and machine shop. The office buildings include all business and technical bureaus, drawing rooms, etc. From the left wing of the same the stock piles are under ready observation, so that note may be taken of the condition as regards material of the various sorts. The entire plan is arranged to cover a minimum area, not alone to reduce the distance of transporting material, but also the better to provide for efficient oversight and administration.

And thus I will close this study with the hope that it may furnish many suggestions for the future; that, moreover, the shipbuilding industry in Germany may be stimulated through the brilliant developments of the last few years to still further widen its influence, to found new dock yards, to strengthen its hold on the markets of the world, and to enter into live competition with the yards of our foreign competitors.

Steamer Korea.—The Pacific Mail steamship *Korea*, which was described in MARINE ENGINEERING for June, 1902, has arrived at San Francisco and will be placed in the China service.

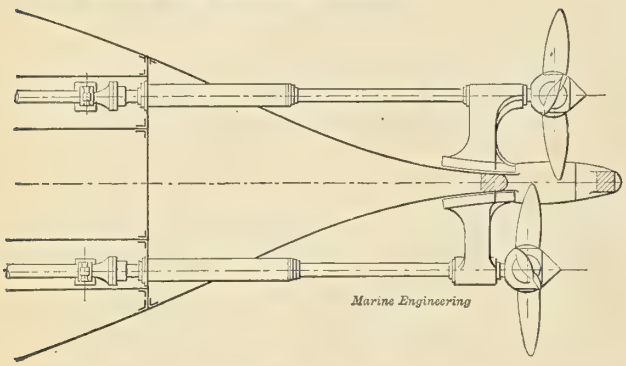
Year's Shipbuilding in the United States.—During the fiscal year ended June 30, 1902, the Bureau of Navigation reports that 1,657 vessels of 473,981 gross tons were built in the United States and officially numbered, compared with 1,709 vessels of 489,616 tons for the previous fiscal year. The decrease compared with last year is in sail vessels and canalboats, barges, etc. This year's new sail tonnage is 101,072 tons; last year's, 128,099 tons. New steel steamers aggregate 275,479 tons compared with 235,265 tons last year.

Reconstruction of Turkish Battleship Messoudyeh.

BY DAGNINO ATTILIO.

The Turkish battleship *Messoudyeh* has just undergone an extensive reconstruction at the yard of Messrs. Ansaldo, of Genoa. In 1890 a sister ship, the *Mendouhiye,* was remodeled and new propelling machinery fitted, but the single screw was retained. However, with the first-named ship the Turkish Government decided to convert her into a twin-screw ship, and the work has been carried out in a very substantial way.

In a vessel not intended for twin screws the attachment of the stern brackets to a stern not especially strengthened and constructed to receive them is likely to be a source of weakness. Referring to the accompanying drawing, we see that on the *Messoudyeh* advantage has been taken of the existing propeller opening to bring the two screws close together and thus reduce the leverage as much as possible. The feet of the stern brackets are extra broad for attaching to the hull. The weight of brackets and shafting is well supported by a flange with a T-shaped bar at the bottom of the frame, and the structure secured was so rigid that it was decided unnecessary to close in the shaft with plating and spectacle frames.



ARRANGEMENT OF TWIN SCREWS AND BRACKETS ON MESSOUDYEH.

The inner and outer bottoms were found to be in excellent condition, and, as the ship was well built throughout, she is considered to be good for many years of service.

The new propelling machinery consists of two sets of triple-expansion, four-cylinder, inverted engines of 11,000 H. P. Steam is supplied by 16 water-tube boilers of the Niclausse type, arranged in four groups of four boilers each. Both engines and boilers were constructed by Messrs. Gio. Ansaldo and Company, in the shops at Sampierdarena, near Genoa.

On the trial trip of the *Messoudyeh,* which was recently held, an average of 16 1-2 miles was maintained for six hours. Steam pressure was 300 pounds at the boilers and 250 pounds in the high-pressure valve chest. The feeding apparatus worked very well throughout, giving little trouble, and no accident happened to the engines or machinery. The main engines reached a maximum of 108 revolutions, driving the ship at 17 1-2 miles. As the contract required only 15 miles an hour, the results attained were satisfactory. The new machinery and fittings represent the highest type of marine work. The armament consists of Vickers breech-loading rifles.

INTERIOR DECORATIONS OF THE HELENITA.

The decorations of the saloons and state rooms on the steam yacht *Helenita* are as handsome as anything of the kind seen afloat. A general description of this yacht was given in MARINE ENGINEERING for July, but the accompanying views were taken recently, and show the yacht as she is at present. The interior work was designed and executed throughout by the Pottier and Stymus Company, New York city.

The forward deck house contains the dining room and smoking room; the former, taking in the entire forward part of the house, is of English oak with backgrounds of carving carved out of the solid, and the ground of same is picked out in red. Over the sideboard is a painting on the wood panel of a marine view, which is stained into the wood and shows the grain throughout. The ceiling round the mast is handsomely decorated with carving, and, with the mast as a center feature, there is an English oak extension dining room table with the extension end forward of the mast. The chairs are of English oak and the backs are carved with prows of ships. The hangings are of green velour and the floor is covered with a green Wilton carpet. The general design of this room has been executed in the Norwegian style.

The smoking room is entered either by a passage from the dining room or from the deck on the opposite side. The decorations are of the Dutch style, with side wainscoting, and treated the same as the dining room. Over the settee is a wood painting, also executed similarly to that in the dining room. The settee is of red leather and the curtains are of red reps.

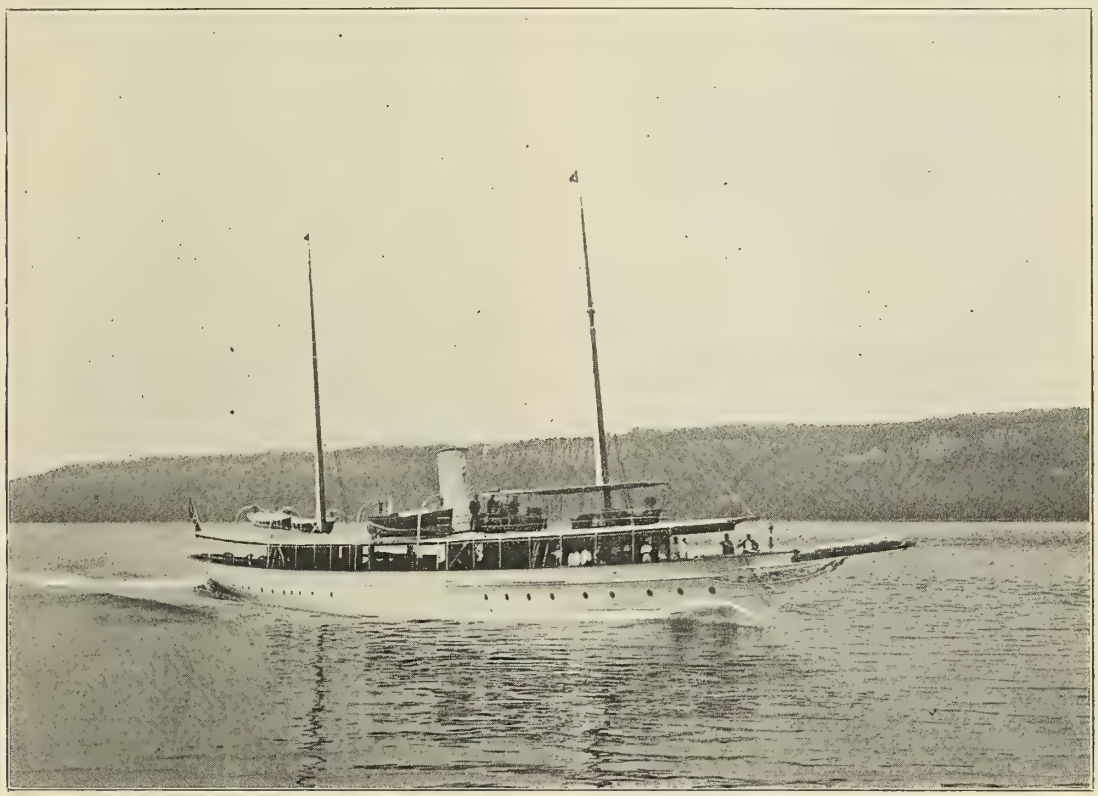
The main salon, or music room, is in the after deck house. It is executed in mahogany with panels of crotch veneer; the woodwork is inlaid marquetry and the general style of decorations is modern English; the ceiling beams are supported by cupid brackets made of special design; the curtains and upholstery are of blue. A very handsome clock, with dolphins carved in the case, ornaments the mast. The piano, secretary's desk, the library and other furniture have been made to harmonize with the design. A staircase leads to the lower hall, the caps of the columns, or newel posts, being ornamented with carved mermaids carved out of satinwood, and the balustrade with carved dolphins between the rails. The curtains and coverings are of printed velvet.

At the foot of the stairs, and at the after end of the ship, is a double state room extending from side to side of the boat. A large bedstead is built at either side, with cushioned seats below. The panels at the side of the beds and the cushions are of printed velvet, and the decorations forming the center feature of the headboards of the bedsteads are carved dolphins. This room is finished in satinwood. Another guest's room is finished in birch in the modern English style, treated simply throughout with large plain panels of selected veneer. The headboard of the bed is painted with two allegorical figures on wood, representing travel and pleasure. The decoration on the bureau and side of the bed is on the same style as that of the room. The ceiling is decorated with simple bands of colors between beams, and the side walls with fine diaper pattern in tones of green and purple.

Another state room is furnished in bird's-eye maple with the ornament applied in birch moldings, forming raised panels. The doors and panels are of specially selected maple veneer, and the ceiling is laid in small ornamental bands in blue, forming panels. The side walls are decorated an all-over-pattern of blue on a cream ground, and the curtains are also of blue. A simple but very effective decoration is that of the white and gilt room in the Louis XVI. style. The entire room is in ivory white. The coverings and curtains are of pink and green stripes with chintz coloring and carpet selected to match.

tric features are of a greenish-gray gold, especially handsome. Forward of this state room are a bath and toilet rooms, and other bath rooms are provided *en suite* for the guests' rooms. All these bath rooms are decorated in white enamel and have cork tile floorings, and in each is placed a wardrobe.

The general dimensions of this yacht are: Length over all, 185 feet; length on water line, 150 feet; beam, molded, 22 feet; depth, molded, 12 feet; draft, 9 feet. With these limiting dimensions, the designers have made the best use of the space to the advantage of the owner, Mr. Frank J. Gould.

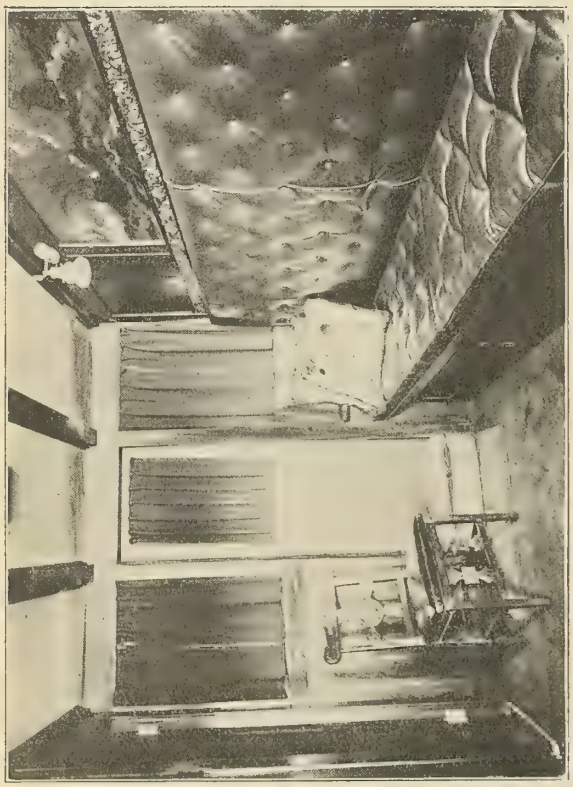


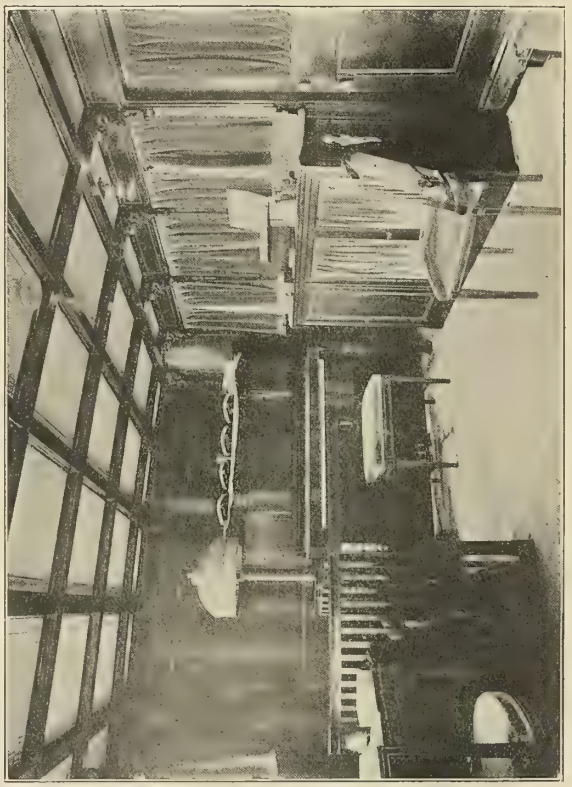
STEAM YACHT HELENITA, BUILT BY THE GAS ENGINE AND POWER COMPANY AND CHARLES L. SEABURY AND COMPANY CONSOLIDATED.

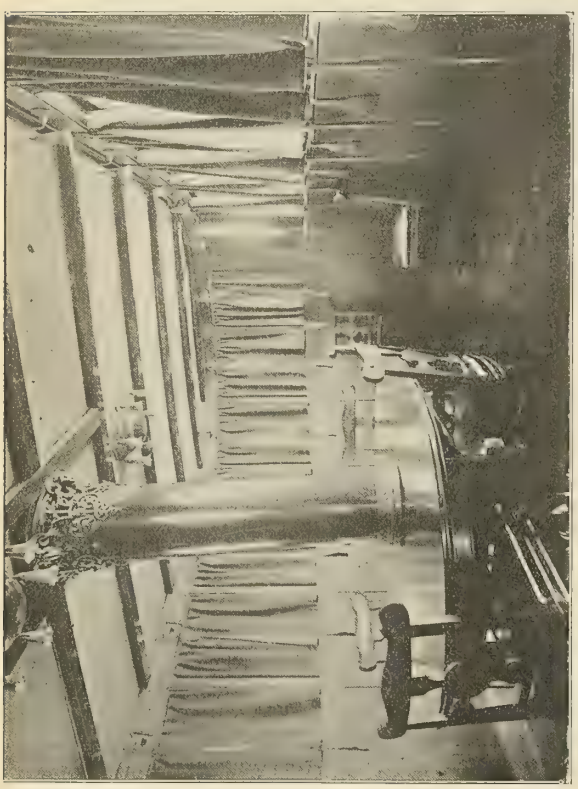
At the forward end of the passage leading from the lower salon is the owner's state room, which, naturally, is the handsomest of all. The wood used is satinwood inlaid with marquetry of white holly and ebony, and only the best selected woods have been used. Provision has been made for dividing this state room into two rooms by a portable fore and aft center line bulkhead, the material for which has already been cut out and can be easily erected. Large oval mirrors with gilt frames form the center feature of the large panels. There are settees at either side, covered with gray silk grounds with figures of gray, green, and purple, and the curtains and cushions are of the same material. Under each settee are chests of drawers, and the chiffonier and dressing table are the same designs as the room. The ceiling is decorated with a pearl-gray ground with an ornament of soft emerald and salmon, pink, and green. The general design of the room has been executed in the English Renaissance style. The hardware and elec-

United States Steel Corporation Earnings.—The net earnings of the United States Steel Corporation for the quarter ending June 30 were $37,691,696, an increase of $11,329,696 over the same period last year. Quarterly dividends of 1 3-4 per cent. on the preferred stock and 1 1-2 per cent. on the common stock were declared.

Roach's Shipyard.—The entire $1,000,000 stock of Roach's Shipyard has been taken over by the Delaware River Ship and Engine Building Company, incorporated under the laws of New Jersey, with $5,000,000 capital; $2,500,000 5 per cent. bonds will be issued. John B. Roach is president of the new company, and D. E. Ford, formerly of the Standard Oil Company, will be general manager; Edward L. Levy, formerly connected with Neafie and Levy, will be vice-president and treasurer; and Osborn Congelton will be vice-president. The company has now under contract two large coast steamers, one for the Savannah Line and the other for the Mallory Line.



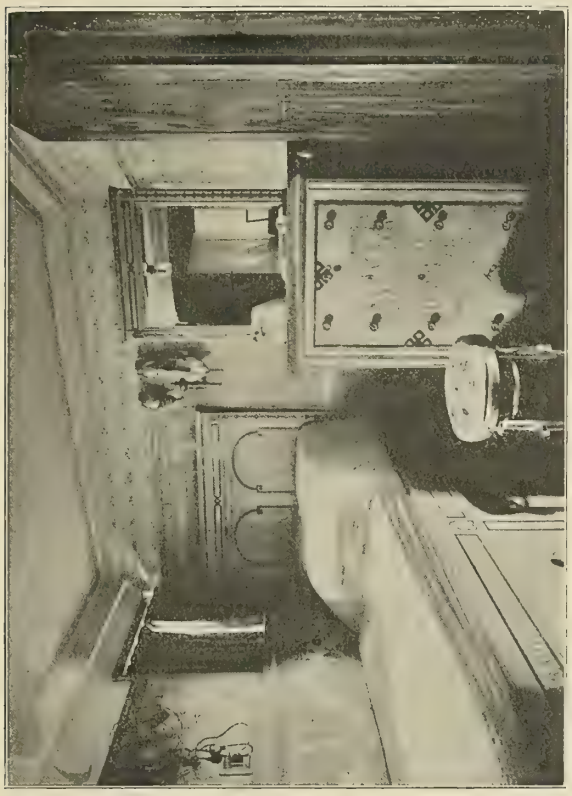


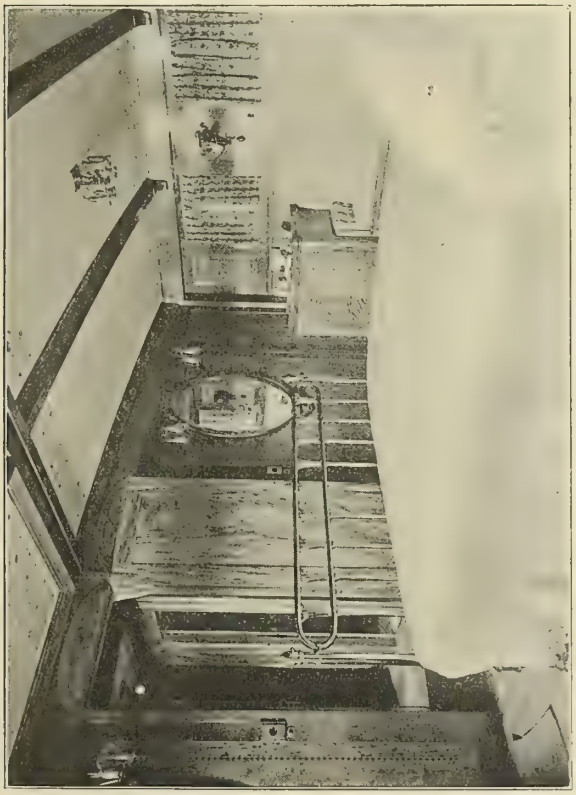


INTERIOR VIEWS OF DECK CABINS ON THE HELENITA.

Smoking Room.
Main Salon, Looking Aft.

Dining Room, Looking Forward.
Main Salon, Looking Forward.





VIEWS BELOW DECK ON THE STEAM YACHT HELENITA.

Guest's Room, Bird's-eye Maple.
Lower Cabin and Stairway.

Owner's State Room, Finished in Satinwood.
Guest's Room, in Gold and White.

Marine Engineering

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WE have before in these columns referred to the gasoline engine and other motors of the same general type, chiefly with reference to their use for pleasure purposes. The gasoline engine, as representing the type of such motors, merits, however, a word of notice with regard to its uses for more purely economic purposes. It has already found its way into boats of small size used for a variety of useful purposes, and with an increase in the sizes in which it can be made practicable there is every reason to expect an increase in the uses of this character. It is perhaps fair to say that with engines of this type it has not thus far been found practicable to carry the power developed in a single cylinder much beyond 20 or 25 horse power. Cylinders can, of course, be multiplied in number to three or four, so that an engine of perhaps one hundred horse power is not beyond reach at the present time. The gasoline type of engine possesses well-known characteristics, which need not be here repeated in detail, and within this range of power it may fairly merit consideration for industrial and commercial uses as well as for pleasure.

For small short-run excursion steamers, light ferryboats, small shallow-draft screw steamers for all purposes, and for all craft fitted with auxiliary power, as fishing craft, oyster boats, etc.—for all of these the claims of the gasoline engine command reasonable and fair consideration.

There is one feature, however, which should not be overlooked, and which seems to render the gas engine relatively less suitable than the steam engine for purposes of the general towboat character. This results chiefly from the relatively irregular crank effort with such engines, and from the extent to which inertia is called upon to carry the engine through the non-working stroke or strokes. A distinction enters here between the so-called two and four-cycle types. In the former one stroke in two or one per revolution furnishes power. In the latter, one stroke in four or one in two revolutions gives power. It might be expected that in this respect the two-cycle type would possess marked advantages over the four. This expectation is, however, scarcely realized, and with a little higher speed of revolution in the four-cycle type there seems to be no marked difference in this respect.

It might also be expected, with one power stroke in four in one case and one in two in the other, that there would be considerable advantage with the latter regarding the weight required for a given power to be developed. With the somewhat higher revolutions referred to, however, and the attendant modifications in structure, the difference in this respect seems to be but slight and in any event not sufficient to furnish a determining feature between the two systems. The chief actual point of difference between the two types, four-cycle or two-cycle, seems to be in the difference in their efficiencies as heat engines. Careful tests involving a measure of the power delivered and the gasoline consumed show a marked difference in favor of the four-cycle type, which is only what might be expected when the features of the two types are compared. Thus far the four-cycle type has attracted but small attention for marine purposes. In spite of a somewhat greater apparent complexity, however, it seems to possess greater certainty of action and superior efficiency. The latter consideration, especially, is one which will have weight in connection with commercial uses, and we believe that there is a fair field for further effort looking toward the better adaptation of gasoline engines in general, and especially those of the four-cycle type, to marine uses of a commercial and industrial nature.

WE would call attention to the conclusion, on another page, of the article continued from last month relating to shipway and dock handling appliances, especially as represented by the leading practice in the large German yards. This article, translated from the annual volume of proceedings of the young but vigorous German Society of Naval Architects and Marine Engineers, gives without doubt the most extended and detailed discussion of this important topic which has yet been published. We have been inclined, in this country, to consider that we are far in the lead of the world in methods for handling grain, coal, ore, structural material, etc., and in general there is undoubtedly reason to admire the energy and skill which American engineers have displayed in this field. We should not forget, however, that foreign engineers are also at work on these same problems, that they are well acquainted with the methods most in vogue in this country, and that in their own way they are finding solutions worthy of our careful attention. In particular is this true in the field of marine construction, and the display of designs and actual construction in the original article, only a part of which could be reproduced, shows how much attention German engineers are giving to the problem of handling and distribution in connection with marine work.

We are not likely, in fact, to exaggerate the importance of this matter in connection with carrying on engineering work on a large scale. An efficient and adequate system of handling saves time by accomplishing this part of the work far more quickly than it could be done by hand; it saves expense by substituting mechanical energy for the human energy of an army of men, and it saves time and promotes efficiency, both in the shops and at the ship, by doing the work of handling and distribution with far greater certainty and efficiency than could be done by any army of men, no matter how numerous or how well trained. The need of an efficient system for carrying on this part of the work is now considered as important and as necessary a part of the equipment of a shipyard as the tools for preparing the material, or as the shipway itself. We would commend the article by Herr Schwarz to the study of all who are interested in this problem, and can assure them that they are likely to find much therein which will be helpful and suggestive in their consideration of the many questions involved.

SHIPBUILDING on the lakes is looking forward to another year of prosperity. The general condition may be best indicated by the fact that at the present time some twenty vessels are under contract in the yards of the American Shipbuilding Company, with several more in the yards not under the control of the combination. In looking over the dimensions of these vessels, it is interesting to note the small number of classes into which they fall. Ten of them are of "canal size"—that is, of suitable dimensions to pass through the locks on the Canadian canals and thus permit of passage to the Atlantic coast. These vessels are, therefore, 241 feet long on the keel by 41 feet beam and 18 feet depth. The other ships under contract are mostly in the class of large freighters and fall into two classes—one 380 feet long by 50 feet beam by 28 feet depth, and the other 414 feet long by 50 feet beam by 28 feet depth. It is of interest to note to what an extent lake shipping tends to standardize itself into classes. Aside from passenger steamers, there are three well-marked types or classes of cargo steamers—the small steamer, 200 to 220 feet long by about 40 feet beam and 16 feet depth; the large steamer, about 400 feet long, 50 feet beam, and 28 feet depth; and the canal size, as noted above. Sizes and dimensions of engines and boilers also tend to fall into the same standard classes. The steam pressure, as a rule, is 170 pounds, and the engines are all three-cylinder, triple-expansion. Natural and assisted draft are both used, in the latter case both the Howden and Ellis and Eaves systems being employed.

The lake ship operator and ship builder both have peculiar problems to meet in connection with the local conditions of water and traffic, and between them it is certain that they have evolved a peculiarly efficient type of boat having in view the service required. These boats combine moderate draft, fair speed, good coal economy, unrivaled facilities for loading and unloading the cargoes they are intended to carry, and such a measure of strength, general safety, and convenience of life on board as the conditions of lake service are found to require.

If the conditions of commerce and industry in general and of shipbuilding in particular may be in any measure safely inferred from those of shipbuilding on the Great Lakes, the coming season bids fair to be one of continued activity and prosperity for all concerned.

MISHAPS AND REPAIRS.

Repair of a Feed Pump.

After two years of working, a feed pump of cast iron, similar to the sketches, 1, 2, 3, broke down as shown at *A*. At this place there was a weakened part, and the boss provided for the fitting of the return cock broke down. This pump was removed and another one furnished by the builder of the machine was put in its place. After about three years almost the same mishap took place. There was faulty design and faulty molding.

The following repair was finally decided upon:

1. The valve seat *D* was removed.

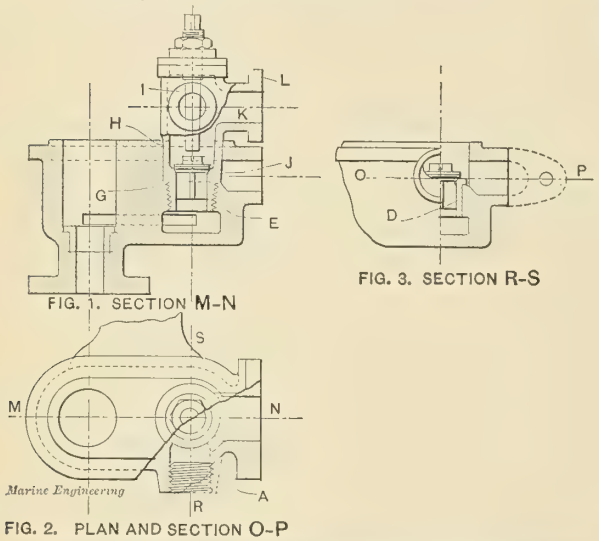


FIG. 1. SECTION M-N

FIG. 3. SECTION R-S

FIG. 2. PLAN AND SECTION O-P

2. The part *E* was threaded, the part *G* was dressed on a lathe, and the part *H* was bored at the same time.

3. A box, *I*, in brass was made, containing the valve seat at *J*, the boss *K* to receive the same return cock, and a strap or bridle, *L*, to receive the feed pipe.

4. This box was turned and fitted in place, making a tight joint at *G*.

5. The feed pipe was changed so as to be connected at the strap *L*. The same operation was made at the return pipe.

This repair was made seven years ago. We have visited it lately and it was in very good condition. The pump has been in continuous operation. J. M.

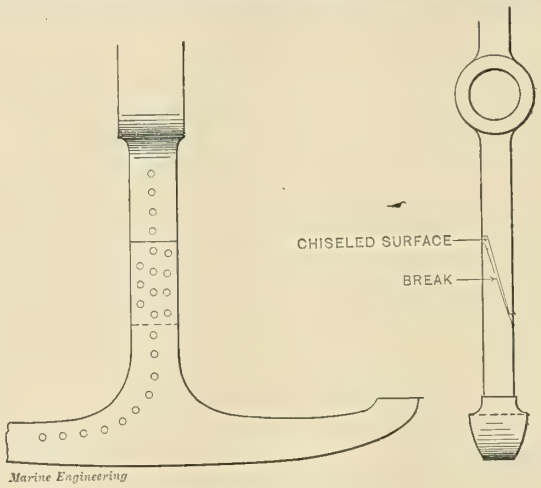
Broken Stern Frame.

The interesting account of repairs made to the stern frame of the tug *Tatoosh*, which appeared in the July number under *Mishaps and Repairs*, reminds the writer of repairs made to a forged stern frame on a towboat on the Atlantic coast some time ago.

We had docked the tug *N*—— for general overhauling to the bottom, and only then discovered a crack in the stern post below the propeller boss. Close examination showed that the frame was cracked entirely through, as shown in the cut, evidently along the line of the weld of the upper and lower parts.

The *N*—— had a balanced rudder supported from the deck, and the whole rested in a shoe at the stern frame. It was, therefore, necessary to have the lower end of the frame well braced to take the side thrust of the rudder. We could not wait for a new stern frame to be made, and, from the various plans suggested for repairing, I decided on the following:

The plates adjoining the lower part of the stern frame were removed, and the lower end piece taken up to the shop. With pneumatic tools a scarf was made along the fracture of the upper part of the frame, as shown by the dotted line in the illustration. A template was then made, and the lower end of the frame was built up under the forge hammer in the shop to conform to this surface. Holes were then drilled through the scarf of the lower piece, and the frame taken out and put in place. These holes were matched in the other part of the scarf and in the plating. The plates were then put back in place and all of them riveted up, the rivets in the way of the scarf being driven through both



METHOD OF REPAIRING STERN FRAME.

pieces of the frame and the side plating. By this means we avoided putting on tie plates over the crack, which would have necessitated driving the rivets through the stern frame and four thicknesses of plating.

The tug has been in constant service for over a year, and, upon docking a few weeks ago, examination of the fracture showed no indications of the rivets having started. H. D. F.

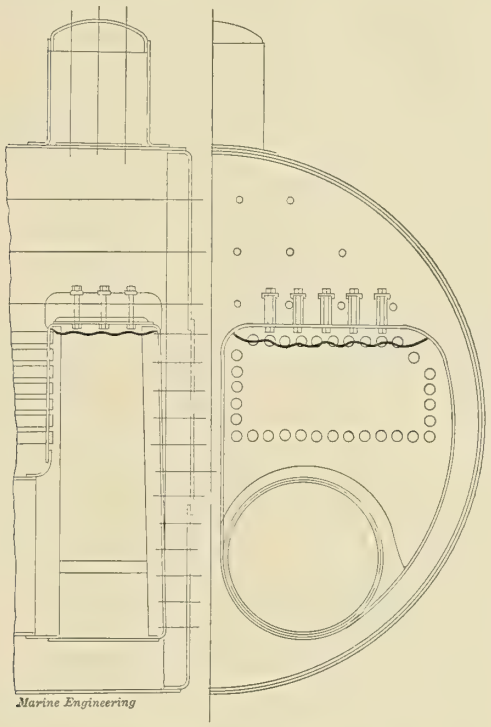
Collapse of Crown Plate of Main Boiler.

Editor Marine Engineering:

There has recently been up for examination before the British Board of Trade a case of boiler explosion which was the direct result of placing an incompetent man to fill the position of chief engineer on a small coasting steamer.

The accident has been brought to my close attention, and I have inspected the boiler myself. The vessel was employed in carrying coal under the English flag. Before leaving port the engineer emptied the boiler and took in fresh water while at the dock, filling the boiler to the height of about a foot above the top of the gage glass, in order to make the passage and discharge the cargo without pumping in any seawater. The donkey boiler was in bad shape, so the main boiler was used for discharging cargo as well as supplying steam for the propelling engines. On the passage priming occurred, as was to be expected, but neither during

the passage of ten hours nor while discharging cargo with two steam winches for about 8 1-2 hours was any water level visible in the glass. The glass was frequently blown through by opening the drain cock, but it was always found to be "full glass," and therefore no water was pumped into the boiler. On getting out to sea again, the high-pressure slide valve began to screech, and later on, while the fireman was removing a bag which had been tied around the main steam pipe and which had taken fire, and the engineer was again blowing through the gage glass, the furnace doors were blown open and the contents of the boiler were emptied into the stokehole, without, however, injuring the engineer or fireman, who managed to escape on deck. The vessel was disabled and had to be towed back to port. The drawing shows the condition of



COLLAPSE OF A CROWN PLATE.

the port combustion chamber crown, which had collapsed to the extent of about 7 inches. The crown of the starboard combustion chamber was severely distorted, but none of the stays gave way. The sides and tube plates of both chambers and the upper rows of tubes were so damaged that it was decided to fit a new boiler. At the time of the explosion the working pressure was about 70 pounds per square inch. On inspection, the valve on the steam space of the boiler communicating with the top of the water gage was found to be completely blocked with soft deposit, and consequently, when the gage glass was blown through by opening the drain cock only, the water was forced above the top mounting, giving the appearance of a full glass. Had the man in charge tested the water gage by what is known as the "double shut-off" method, he would at once have seen that the steam passage to the gage was obstructed. The chief engineer was not a trained mechanic and possessed no certificate, but had had many years' experience as an engine driver at sea, and was regarded as an exceptionally careful and steady man. J. M. H.

QUERIES AND ANSWERS.

Q.—If the high-pressure cylinder of a compound engine was disabled, would it be safe, after hanging up the high-pressure piston on the top center, and removing the high-pressure valve, to run the low-pressure without blocking the top steam port, or would it be better to drop the piston to the bottom and shore it down? If you know of any better way to fix the engine so that the ship could be brought to port, you would oblige by letting me know; also if it would be wise to try and dock the ship while working the low pressure only? F. S. S.

A.—We should prefer to drop the piston to the bottom of the stroke and shore it down, at the same time plugging or blocking off the steam ports leading to the cylinder, but more especially the one at the bottom. As to whether this would be more convenient than the first method you proposed, would depend on the circumstances of the case. If the high pressure connecting rod were disconnected there would be nothing in the way, and the piston with rod and crosshead might readily be dropped to its lowest position. If the connecting rod were not disconnected, however, and thus gave motion to the crosshead, it would be necessary to shore the piston in its topmost position, and in such case the top ports should be, of course, carefully blocked off.

If one cylinder is out of commission there is probably no better way to bring your ship into port than by disconnecting such cylinder and proceeding with the other. As to whether it would be wise to try and dock the ship while working the low pressure cylinder only, this would depend entirely on the special circumstances of the case. We have seen single crank engines which handled so readily that a ship could be docked without any special difficulty whatever. In such a case as you assume, however, with only one cylinder of a compound, it might be doubtful if the adjustment of the valve would be that best suited to the quick operation of the cylinder as a single engine. If there were any doubt on this point we should be inclined to employ the services of a tug for docking the ship.

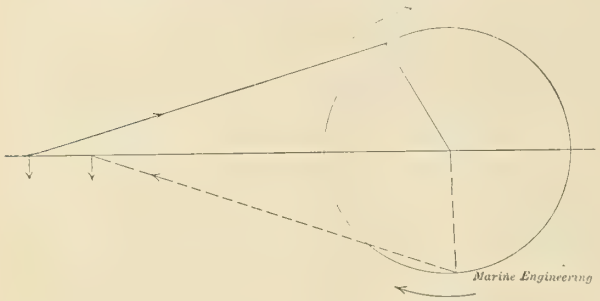
Q.—I have a feed pump; the ratio between steam piston and water piston surfaces is 2. Is the ratio between steam boiler pressure and water feed pressure in delivery pipe equal to 2, *whatever* being the feed water valve's opening? D. A.

A.—The answer is no. With the feed check well open the pressure in the feed pipe is only slightly above that in the boiler, except as momentary shocks may cause it to rise higher. The extra load on the piston due to its larger area is taken up by overcoming the friction of the moving parts of the pump, and the inertia of the water from rest in the barrel of the pump to motion through the feed pipe. As the feed check is closed down or as the feed pipe is longer and has more angles, bends and turns, or as the pipe becomes smaller for the amount of water flowing through it, more and more pressure will be required on the water side of the pump to force the water through the pipe into the boiler through the check valve. In such case it may require nearly the whole load on the steam end of the pump, and the pressure in the water cylinder may be nearly twice the full boiler pressure. Usually, however, the steam is throttled before entering the steam chest of a feed pump, so that it is rare that full boiler pressure is brought to bear on the steam end of the pump. In case it has full pressure, with feed check wide open and a good sized pipe with straight lead, the pump will be liable to run away; that is, slam and pound, the unnecessary pressure on the steam side being absorbed in producing this violent motion in the column of water in the feed pipe.

Q.—How would you determine on which guide the pressure acts in case of an inverted vertical engine driving a right handed propeller? A.

A.—In considering this question it must be remembered that the engine operates by reason of the pressure on the piston, and that in consequence the crank is pushed down on the down stroke and pulled up on the up stroke. Having this in mind and referring to the diagram it will be clear that on the down stroke,

due to the obliquity of the connecting rod, the reaction upon the crosshead will tend to *push* it over transversely, producing a lateral pressure on the guide *opposite* to the side on which the crank is then found. On the up stroke, on the contrary, the obliquity of the rod will tend to *pull* it over transversely, thus producing a lateral pressure against the guide on the *same* side. It results from this that the pressure on the guide is always on the same side so long as the engine is turning in any one direc-



tion. It is also clear that this side is that on which the crank is located on the up stroke. As a general rule, therefore, we have the following:

The guide which carries the load is on the side occupied by the crank during the up stroke or during the stroke toward the cylinder.

In the particular case which you mention the guide on the port side would therefore carry the load so long as the engine was turning ahead.

Q.—I would like to have the following question answered: M. J., a marine architect and ship carpenter, hires out by the day to design, superintend and build a steamboat for A. D. Co., the latter party finding all material. M. J. first makes a model and a set of patterns and then builds the boat. *Who has a right to the patterns?* Has A. D. Co. a right to use and dispose of these patterns without M. J.'s consent? M. J.'s experience and study of 30 years are embodied in these plans and patterns.

A.—This is a difficult question to answer without knowing further particulars of the contract entered into between the two parties. If M. J. is simply hired by the day to build and superintend the boat, all of his work belongs to A. D., as is the case with every machinist or workman who hires out. If, however, M. J. agrees to design and superintend the building of the boat, the designs are his own. This latter course is the one usually adopted by naval architects, but, from the information you give us, we believe that by the terms of the contract M. J. has no claim for any of the products of his work while hired by A. D. Co.

Q.—1. Are there any objections to a *steel* hull for a gasoline engine-driven boat?

2. Would there be more danger of explosion in the gasoline tanks on a very hot summer day in a steel hull than in a wooden hull, the boat being constantly practically without motion in the rays of the sun?

E. K.

A.—1. There appears to be no special reason why a gasoline engine should not be used in a boat with a steel hull.

2. It should be remembered that gasoline in itself is not subject to explosion. It is only when its vapor is mixed with a suitable quantity of air that such danger arises. It should be further remembered that gasoline vapor is heavier than air and that therefore after formation it will tend to settle to the lowest point attainable and there collect. To explode a mixture of gasoline vapor and air a relatively high local temperature is needed. For this reason a spark is commonly employed in gasoline engines. This also shows the danger of striking a match or of introducing a light of any kind, or possibly even a glowing bit of vegetable matter such as a lighted cigar, into any space which may possibly contain gasoline vapor and air. The greatest danger in a gasoline boat, therefore, is from a leak into an inclosed space where the gasoline may collect and vaporize, forming the explosive mixture referred to above.

Regarding danger from exposing a gasoline tank to the rays of the sun it may be said that the only danger which is apparent is that of developing, due to the heat, a sufficient pressure of gasoline vapor to possibly explode the tank. Such an explosion of course would not necessarily be accompanied by fire. It would mean simply the development of a vapor which might bulge and explode the containing tank. If fire were present an explosion of mixed air and vapor might follow as a secondary result. There does not, however, seem to be any possibility of the direct explosion of gasoline vapor in a tank exposed to the rays of the sun. In the first place the gasoline vapor alone is not explosive, and even if some air were present the temperature required would be far higher than anything likely to be reached under the circumstances which you mention.

Repairing the Steamship Etruria.

Extensive repairs were necessary to the steamship *Etruria* after that vessel reached port, following the accident whereby her rudder post, propeller, and the external portion of the propeller shaft were lost in mid-Atlantic some months ago.

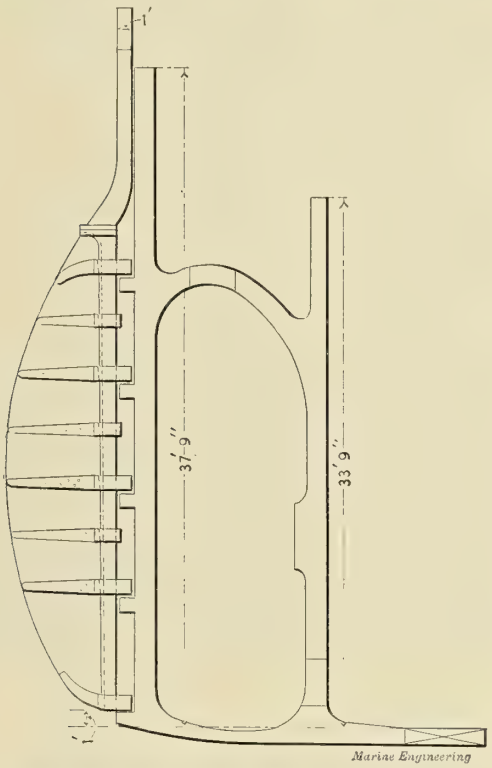
An interesting account of the repairs made is given in the *Engineer*, from which paper the following facts and drawings are taken.

British yards are not generally equipped in compressed air, but it was realized by Mr. Bain, the engineer for the Cunard Company, that the work could be done most expeditiously by the use of pneumatic tools. A pneumatic tool company of London furnished the equipment and certain of the skilled hands, the owners providing the material and labor, and the result was that the work was executed in about a fortnight.

The rudder, rudder post, and the lower part of the stern post being lost, a new forging for the rudder post was provided by the Dumbarton Forge Company. Owing to the enormous size of this forging, it was made in two portions joined by a scarf at the bottom of the rudder post, the scarfs on the forgings being made to template. The corresponding scarfs of the top and bottom stern post were made by pneumatic tools. A number of holes were drilled through the stern post by Boyer drills, and the intervening metal was next broken through by a No. 1 Boyer chipping hammer, using a tool thickened at the end. The drilling of the scarf was commenced at 9 o'clock P.M. on Saturday, the 19th ult., and was finished, with the bottom piece cut away, at noon on Tuesday, the 22d ult.; two No. 2 Boyer drills with 1 1-4-inch diameter drills, and one No. 3 Boyer drill with 1-inch diameter drill, being employed, the latter boring at the rate of 1 1-4 inches deep per minute. In one case, we are informed, a 1-inch hole was drilled 9 inches deep in seven minutes. The No. 2 drills, 1 1-4 inches diameter, bored 7-8 inch deep in one minute on an average. After the holes were thus broken through, the remaining metal was chipped to template by pneumatic hammer and chisel, the time occupied in this process being about thirty hours. The forgings were next clamped in position without much further tooling being necessary to make a good joint. Some heavy drilling was then rendered necessary for the rivet holes, of which there are twenty-four in each of the two lower joints, *A C*, Fig. 2, and fifteen in the upper joint, *B*. These were drilled 1 5-16 inches diameter, and were afterward reamed out by the same

machines to 1 1-2 inches diameter, great care being taken to prevent any movement of either of the abutting parts. Ordinary twist drills 1 5-16 inches diameter were used, and with 100 pounds air pressure a hole 12 inches long was made in fifty-five minutes, including four stops to lower down the drill on the stand. The countersinking was done with the same machines, by the aid of a special tool, with a cutter to fit the drill socket. The rivets were 11 1-4 inches long and 1 1-2 inches diameter, the heads being 2 1-4 inches diameter and 1 1-4 inches long, and the other end of the rivet had 2 3-4 inches of taper. They were made in the Cunard Company's shops, accurately turned to fit the holes tight.

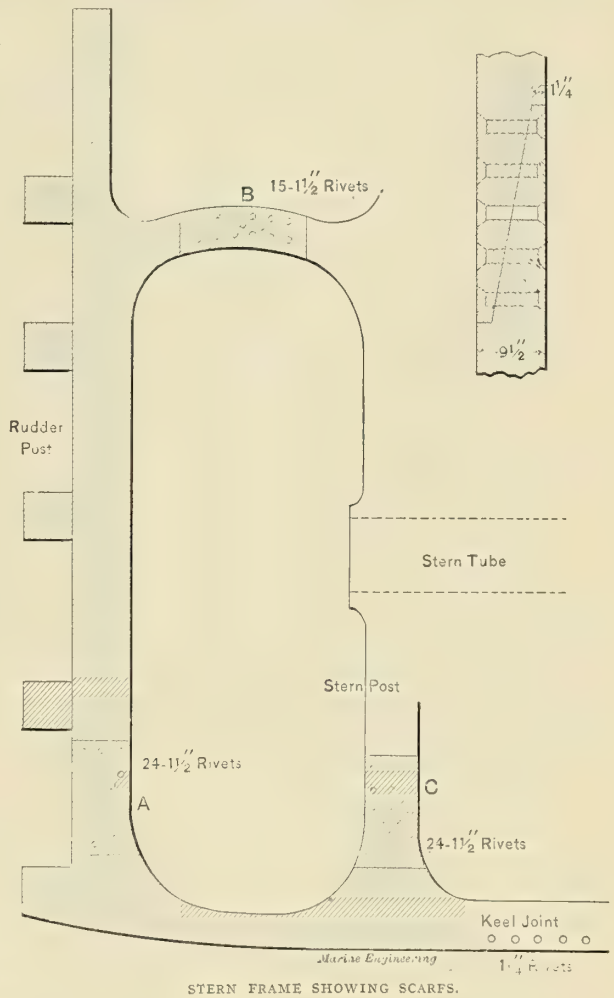
After the holes in the scarf were finished, a start was made with riveting, two Boyer riveters 1 3-4 inches by



NEW STERN FRAME AND RUDDER OF THE ETRURIA.

6 inches being used simultaneously from each side of the scarf. A couple of plates were clamped to the rudder post to provide a bearing for the riveters, and the machines were supported by means of balance weights running on pulleys fixed above the scarf. After being heated the rivets were cooled in water within three inches of their tapered ends, and were then driven into the holes by the machines. When the operator at the opposite side saw that the countersink was fairly filled he started his machine, and in an average of from thirty to forty-five seconds the rivet was close down to the metal. The subsequent cooling of the ends of the rivets caused them to contract, and tended further to close the joint. In the two joints *B* and *C* the heads of the rivets were afterward chipped off with a Boyer hammer to allow of the plating to be fitted closely over them. In the case of joint *A* this was not necessary. Some heavy chipping was necessary after the scarfs were riveted to trim the forging up to shape at the joints.

The repairs necessitated the removal of a number of the skin plates of the vessel, which involved a further large amount of punching and riveting. The keel plate on either side which overlaps the rudder post, for instance, is 18 feet long by 4 feet deep and 7-8 inch thick. Along two sides of these plates two rows of 7-8-inch rivets had to be removed and replaced. This was done by hand riveting. Along the bottom and on either side of the frame there are three rows of 1 1-4-inch rivets, varying in length from 5 3-4 to 13 3-4 inches and pitched



STERN FRAME SHOWING SCARFS.

6 inches center to center. These were replaced by pneumatic tools. Where the outer edge of these plates overlapped the stern post two rows of screw rivets were inserted by hand.

The compressor was placed transversely on the deck of the vessel near the stern, three india-rubber hose pipes of 1-inch bore being carried over the vessel's side down to the tools. The compressor was one of the Taite-Howard Company's standard types, and was supplied with steam from one of the ship's boilers. It may be stated that no difficulty was experienced with the workmen; the Cunard Company's boilermakers handled the tools with some eagerness, both when riveting the 1 1-2-inch rivets and also when doing the heavy chipping.

Saving Weight in Hull Construction.

There are many points in the construction of a vessel where weight may be saved without in any way affecting the strength and rigidity of the structure, and, although the saving in each member may seem trivial in itself, yet the total saving amounts to a quantity which should not be neglected.

One of the methods of cutting down the weight is in clipping off corners of angles and plates. Take, for example, a ship of 300 feet in length by about 40 feet beam; the frames will be 5 by 3 1-2 inches by 9-pound angles; reverse frames, 3 1-2 by 3 1-2 inches by 8-pound angles; the clips, 3 by 3 1-2 inches by 7 pounds, and the floors 20 to 23 pounds. Ordinarily, in the makeup of these essential parts, the corners of all angles, clips, etc., are left on. However, if these corners were cut off considerable saving would thereby result. By noticing the accompanying sketches, the shaded corners are evidently seen to be of no essential value in the construction, and it makes no difference whether they are on or not, as the strength of the member is in no way impaired by cutting the corner off. Any part of an angle left on where it lends nothing to the construction may be considered dead weight, and if it can be done away with at all it is certainly advantageous.

Take an entire frame of such a ship with three decks, where the reverse bars would run up to the main deck and having brackets on each deck, as shown in Fig. 3. The amount of weight that could be saved runs from 5 to 10 pounds per frame, which, in a 300-foot boat, means from 750 to 1,500 pounds. This weight, which does not seem of appreciable value, may be given due consideration when it is considered that no additional cost of frame would be incurred and no part of the ship's structure weakened. Sketch No. 1 shows reverse bar with the two ends cut off, leaving as much material where the cut is made as between the rivet hole and the end or side of flange of the angle, the backing clip with the corners cut, the frame angles shown dotted with corners cut, and the backing bar to frame and intercostal clips, which are double, with ends cut. Following the frame from the center line keelson, there would be at least one side intercostal keelson, which, with clip to floor and lug back of reverse bar for stringer angle shown in Fig. 2, gives four more corners, especially the lug, which may be cut as shown, as also the lugs of the lower and upper bilge stringers. Then the lower deck with bracket to beam may be cut as shown in Fig. 3, the dotted part being cut where bulb or channel beams are used, as the square top to the bracket is of no value, except where it can be put in the bosom of the beam, resting under the upper flanges. A lightening hole of 3 inches diameter in a 20 by 20-inch or 24 by 24-inch bracket takes no material strength from the bracket, yet means considerable weight when the number of brackets in such a ship amounts to 900 or more. Making a summary of the number of corners that could be cut on a single frame, and the amount of their weight, the brackets to decks and the weight of the 3-inch hole and cuts on them, we have for a three-deck ship of 150 frames as follows: For each frame, 52 corners of 3 1-2 by 3 inches by 8 pounds average angle, which amount to about 5 pounds, and 6 brackets per frame, which would come up to about 5 pounds. We thus find that the total saving per frame is 10 pounds, which means 1,500 pounds for the entire ship on framework alone. This idea may be carried out to advantage without any material extra cost, and in no case weakening of structure, where good judgment is exercised.

Besides saving the pounds dead weight, the cutting off of unnecessary corners lends a finished appearance to all visible structural work.

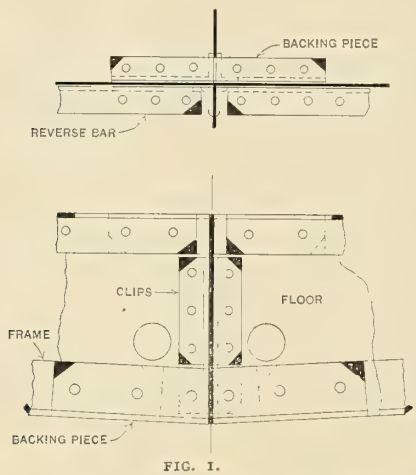


FIG. 1.

CENTER KEELSON, LOOKING FORWARD.

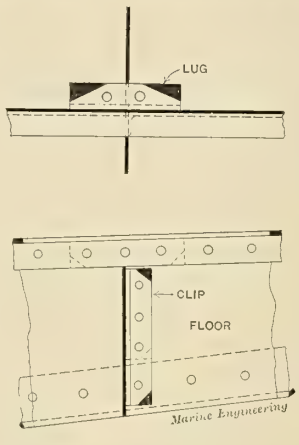


FIG. 2.

SIDE KEELSON, ETC., LOOKING FORWARD.

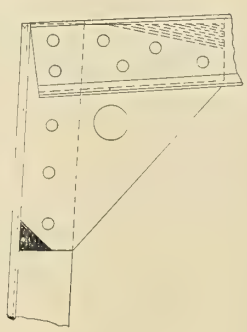


FIG. 3.

BRACKET AT DECK.

Turbine Steamer Queen Alexandra.

Reference has already been made in Marine Engineering to a new passenger steamer for the Clyde service which is being built by Messrs. William Denny and Brothers, of Dumbarton, and the Parsons Marine Steam Turbine Company, of Wallsend-on-Tyne. London *Engineering* makes in part the following remarks: The success last year of the *King Edward* has led to the construction of this new steamer. She is on the same general lines as the older vessel, but is somewhat larger, being 270 feet long, 32 feet in molded breadth, and 11

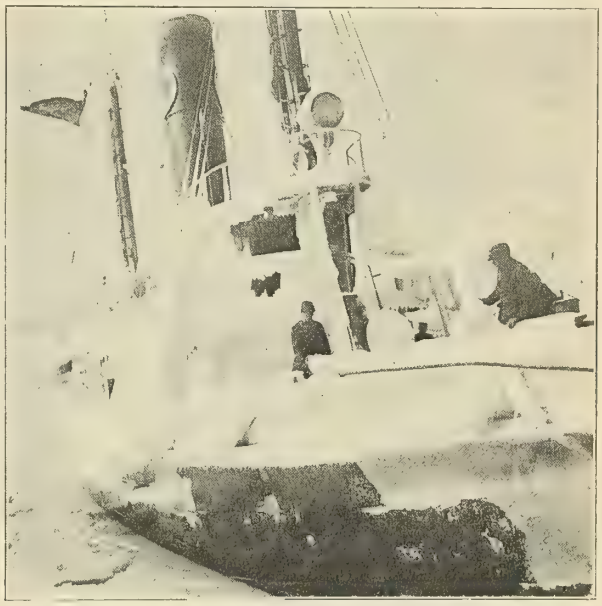
feet 6 inches in depth to the main deck. Were it not for this, the *Queen Alexandra* would so far resemble the *King Edward* that a photograph of one might almost be taken to represent the other. The machinery is practically similar in design to that of the *King Edward*. The vessel, however, is considerably more powerful, having attained a mean speed of 21.63 knots with 1,100 revolutions of the side shafts and 750 revolutions of the center shaft. The vessel is, we believe, the largest passenger steamer on the Clyde, and is also the fastest excursion steamer in Great Britain. Captain Williamson, the managing owner, has given some figures as to coal consumption of the turbine machinery. A vessel of a similar type (the name of which is not stated) steamed 12,106 knots in 80 days on a coal consumption of 1,909 tons, at an average speed of 18 1-2 knots. The *King Edward* steamed 12,116 knots in 79 days on a coal consumption of 1,429 tons, and averaged 18 1-2 knots. Thus the turbine vessel steamed 10 miles more at the same speed on a coal consumption of 480 tons less. It is worthy of note that the calculations had shown that the vessel would make 21 1-2 knots if a certain boiler power were obtained, but that if everything was worked to its utmost limit 21 3-4 knots might be reached. Everything had not worked to its utmost limit, and a speed of 21 5-8 knots was attained, which was exactly what had been anticipated. This proves that the turbine system is now on a sound basis and can be adopted with a due knowledge of what it will do. The past year's service of the *King Edward*, and the fact that those who were best able to judge, namely, her owners, have put on another vessel as a commercial undertaking, show that the steam turbine is fairly well established as a marine engine, and it may be confidently anticipated that it will play an important part, at any rate in passenger and cross-Channel steamers, doubtless leading to its adoption for larger craft. The fact that the Admiralty have taken it up for an ocean-going vessel supports this view.

TUGBOAT STARTING OUT WITH BARGES.

Ocean Towing.

Transporting coal along the coast is annually requiring more barges and towboats, and to-day one will find a large fleet of stanch vessels engaged in this trade. The barges and tugs are built especially for this service and the sizes of both are yearly increasing. Tugboats will generally take three large barges and will average anywhere between 4 and 8 knots speed on the ordinary trip. These tows are going both summer and winter, and encounter very severe weather. When possible, when a storm is approaching, a tug will seek port to wait for the bad weather to pass, but many times they encounter the winter gales in the open sea.

The accompanying illustrations were taken by a Boston *Herald* representative on a trip from New York to Boston on the ocean towboat *Nottingham*. The first illustration shows the barges as towed through the East River harbor at New York. When the open sound is reached these barges are dropped in line one after the other at about 175 fathoms of hawser. The second illustration shows the tug in port after passing through a severe winter storm where the ice formed wherever the flying spray struck the vessel.



TUGBOAT NOTTINGHAM AFTER AN ICY TRIP.

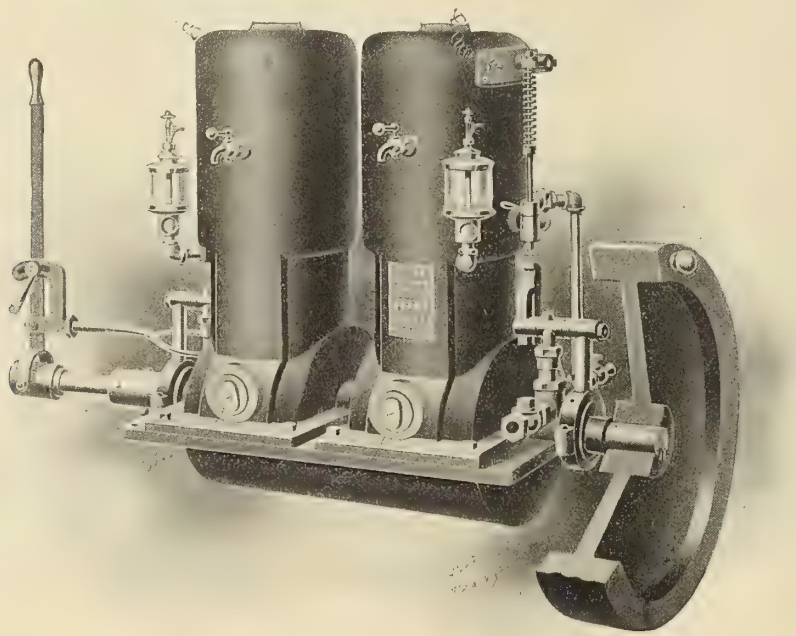
This winter has been one of the severest in the damage done to coast shipping, and the papers have had frequent accounts of barges and schooners wrecked along the coast; but the number wrecked compared to the number in the service is very small. The economy of this method of transportation is being realized, so that yearly these fleets are being increased.

Sea Duties for Naval Officers.—It is the intention of the new Secretary of the Navy to reduce the number of naval officers on shore duty and increase the period of sea service. While the Secretary believes that it is necessary for an officer to have a certain amount of shore duty, yet he believes that most of the time should be spent at sea.

ENGINEERING SPECIALTIES.

Headless Type Gasoline Motor.

The Howard motors, manufactured by the Grant-Ferris Company, Troy, N. Y., for the season of 1902 are from entirely new patterns and follow what is called the headless motor in all types. The smooth, easy finish and rounded form make this motor easily cleaned and kept in order. The sparking arrangement is inserted in the motor in the shape of a small block, which can be easily removed and repaired separately, or a duplicate can be carried. The cylinder, being practically separate from the water jacket and making contact with it at the lower end only, is free to expand and contract without undue strain, and will naturally retain its original shape when subjected to the heat of explosions much better than those motors which have varying thickness of metal at different portions on the shaft, fitting the flywheel and other parts. From the illustration, it can be seen that the oil cups, relief cocks, and handle for varying the spark are in accessible positions. The arrangement of pump and water connections is neat and convenient. A pet cock is provided for draining pump and water jacket in cold weather, and is also a convenience in noting action of the pump in discharging water. In the double-cylinder type the cylinders are rigidly bolted to a single base, giving the stability of a single casting with a further advantage of renewal of a single cylinder in case of accident. The form of generator valve used on two-cycle motors is very simple, and consists of a small cneck valve properly fitted, with a small outlet opening on the side. The arrangement under the valve is such that the spraying of gasoline into the air is absolutely prevented. The throttle is a part of the valve, and is so closely connected to the base of the machine that, without hot-air connection, the valve is kept free from



NEW TYPE GASOLINE MOTOR.

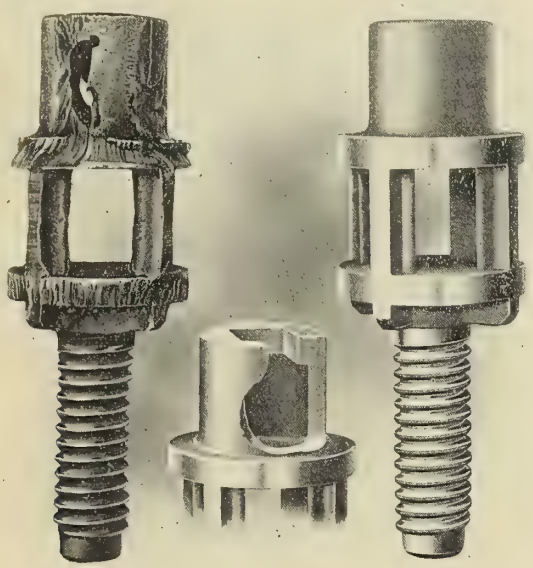
the cylinder, owing to their particular form of construction.

A piston that fits perfectly when the motor is cold need not necessarily be a good fit when the same is hot, the cylinder assuming a different shape, as is also true of the piston. It is also desirable to have the water of nearly uniform temperature at all parts of the motor. This can be done much better when there is a free circulation around the whole cylinder than when it is cut up in sections, one part of which will naturally get better circulation than others. By removing the lower bolts, the cylinder can be removed and taken away. The form of construction at the base is such that the bearings can be renewed and made to fit the shaft, even if it is worn down below size necessary to fit the flywheel and eccentrics. This is not the case when using solid brass boxes, which necessarily must be large enough to pass over the unworn portions of freezing, as a result from the heat due to its proximity to the cylinder. The company also builds four-cycle motors of larger sizes, adopting in their construction the headless type.

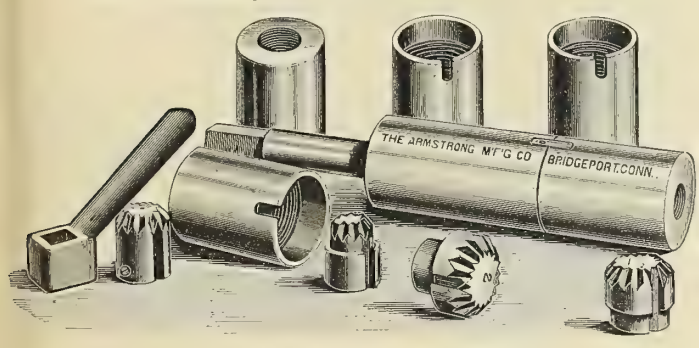
The Effect of Using a Valve Larger than Required.

A practical demonstration of the adverse effect of installing too large a valve in high-pressure steam service was furnished in a Chicago electric station recently. A 2-inch class W pressure regulator was ordered from the Foster Engineering Company, of Newark, N. J. It was placed on a 2-inch pipe containing a boiler pressure of 150 pounds. The delivery pressure was to be reduced to 15 pounds. For delivery of the steam the valve was opened but two or three one-thousandths of an inch. There was about 150 feet of 2-inch pipe between the boiler and the valve which was not covered; consequently, the steam was highly

saturated when delivered. When passing through the valve the velocity of the steam was so high that it produced some cutting, as shown by the accompanying illustration below. This photograph was made after the valve had been in service but four months. The cause of erosion was at once apparent, and a valve exactly one-half the size was installed. This 1-inch valve has been doing good service for two years and is still in operation. The substantial design of the clapper before it was affected is shown at the right. The composition used was 88 per cent. copper, 10 per cent. tin, and 2 per cent. zinc. It has been found that, while the erosion is not always as marked as in this instance, the cause of leaky valves may frequently be traced to the installation of a size larger than is necessary.



COMPARISON OF NEW AND OLD VALVE.



A NEW FORM OF NIPPLE HOLDER.

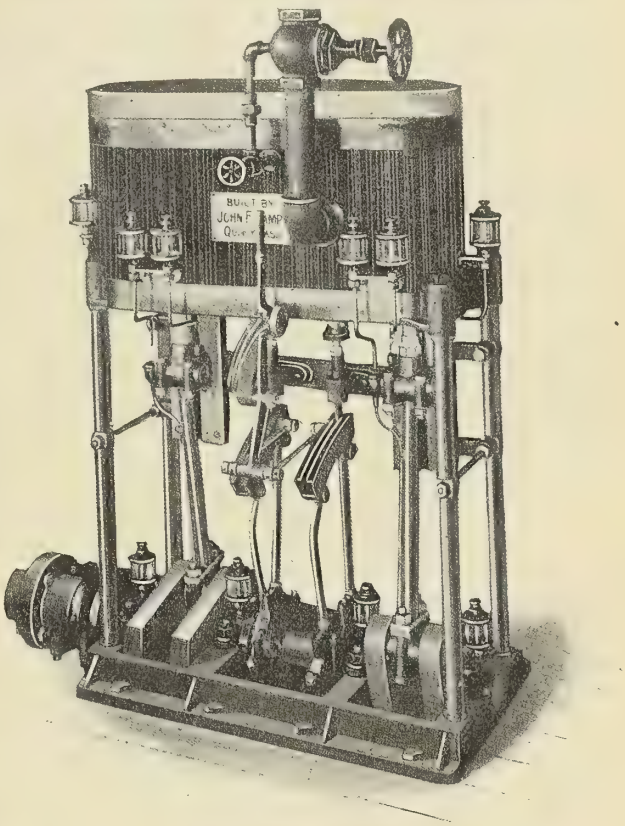
New Nipple Holder.

A new nipple holder has been manufactured by the Armstrong Manufacturing Company, of Bridgeport, Conn., to be used in connection with its No. 00 pipe-threading machine. It holds pipe from 1 to 4 inches, inclusive, by using different threaded rings and backing pieces. It will also hold close nipples either right hand or left hand, no change of parts being necessary to hold the nipple for threading it left hand. When the thread is cut the nipple can be removed with the fingers by loosening the screw in the back of the holder. This nipple holder can be furnished to hold as small as 3-4 inch if required.

Small Marine Engines.

A high-grade compound engine for steam yachts and launches is made by John F. Kemp, Quincy, Mass., and a brief description of these engines is given as follows:

The cylinders and valves are made of hard, close-grained cast iron; the frames separating the cylinders are of open-hearth machinery steel turned to fit reamed holes in cylinder lugs and bed plate. The crank shaft



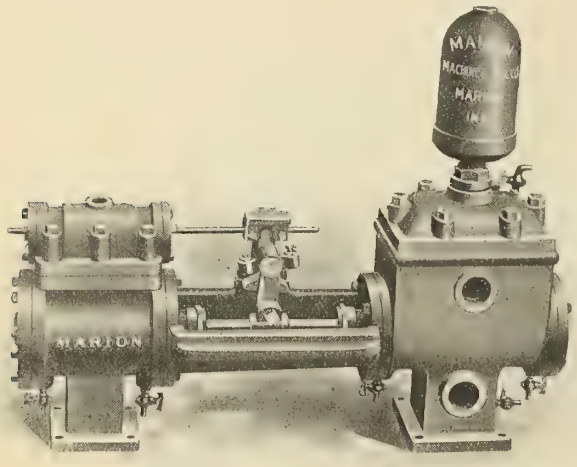
A COMPOUND MARINE ENGINE.

is of forged steel, of the built-up type, and to diminish vibration the cranks are provided with balance discs. The valves of both cylinders are of the piston type, operated by Stephenson links of the box type, and the crosshead guides, bolted to the back framing of the engine, are made for cast bronze slipper crossheads with large wearing surface. The connecting rods, piston rods, links, eccentric rods, and braces are all nicely finished. All bearings are designed with a specially large surface, and a powerful thrust bearing is connected to the after frame of the engine.

The slides, wrist and crank pins are supplied with oil from cups, thus enabling the engine to be oiled while in motion. These engines are made in sizes of from 20 to 85 horse power, the cylinders of the smaller size being 4½ and 9 inches by 6 inches, and of the latter size 8 and 16 inches by 9 inches stroke.

Steam Pump.

The steam pump here illustrated, made by the Marion Machine and Tool Company, Marion, Ind., possesses many features which are essential in the successful working of a steam pump. These are the positive valve motion and the perfect balance of the steam valves. The clearances in the steam cylinder are also reduced to a minimum, thus greatly reducing the amount of steam required. In many pumps now on the market this principle has been overlooked, and marine engineers are beginning to realize the economy of having the auxiliary machinery of good design. The valves are flat-faced, insuring that the wearing



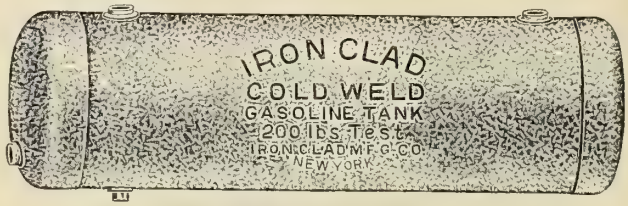
A POSITIVE VALVE MOTION PUMP.

surface will retain, and always wear to, a steam fit. The steam piston is cushioned at the end of the stroke, so that it will not strike the heads, even when under full head of steam and when the pump is working at the highest speed. The adjustment is such that the length of the stroke will not vary when changed from full to minimum load. By this cushion feature the water valves are made easy seating, thus avoiding hammering in the pipes and check valves. Brass liners are fitted in all of the water cylinders, and the piston rod and valve stem are of Tobin bronze. Each pump is supplied with sight feed lubricators, drip cocks, and the necessary wrenches.

Gasoline Tanks.

A gasoline tank for use on launches, combining neatness of design with strength and absolute security, is herewith illustrated. In the construction of this tank the use of rivets is entirely obviated. It is an established fact that every hole punched for rivets not alone weakens the material, but also produces a possibility of a leakage. No dependence can be placed on the riveting of a tank, and to make a riveted tank as secure as possible it is necessary to resort to calking as the only means. The tank here illustrated is of the cold-weld pattern, made by the Ironclad Manufacturing Company, 2-6 Cliff street, New York city, and this type is used for water, oil, or gasoline for small boilers.

In the construction of these tanks, the cylinders, which are made of heavy best-grade flange steel, are locked into a patented and specially-formed T-bar of steel. The flanged, convex heads overlap the cylinder to a depth of 1 1-2 inches, and are secured by the well-known process of brazing, after which they are heavily galvanized to protect them from corrosion. The tanks



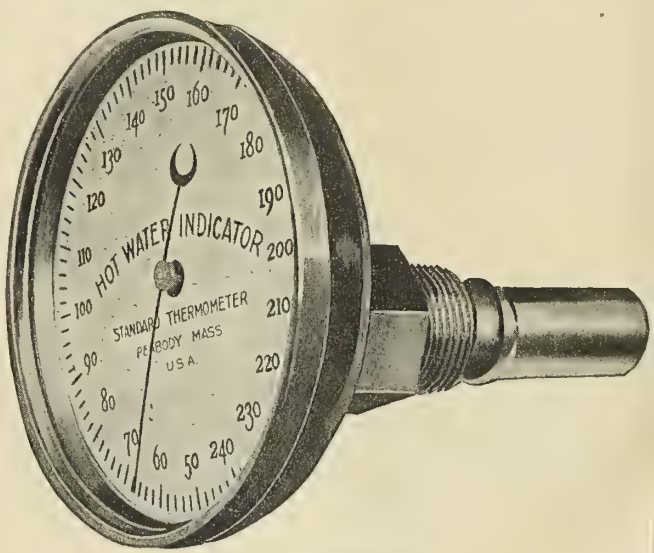
COLD WELDED GASOLINE TANK.

thus constructed are practically seamless, yet stronger, as the material has not been subjected to a heavy draw, but has retained its original tensile strength. Each tank is subjected to an actual hydrostatic test pressure of 200 pounds and thoroughly examined by competent inspectors.

The tappings, which are of best-grade malleables, can be placed in any part of heads and cylinders, in any size from 1-8 to 2 inches in diameter, as may be required.

Standard Thermometers.

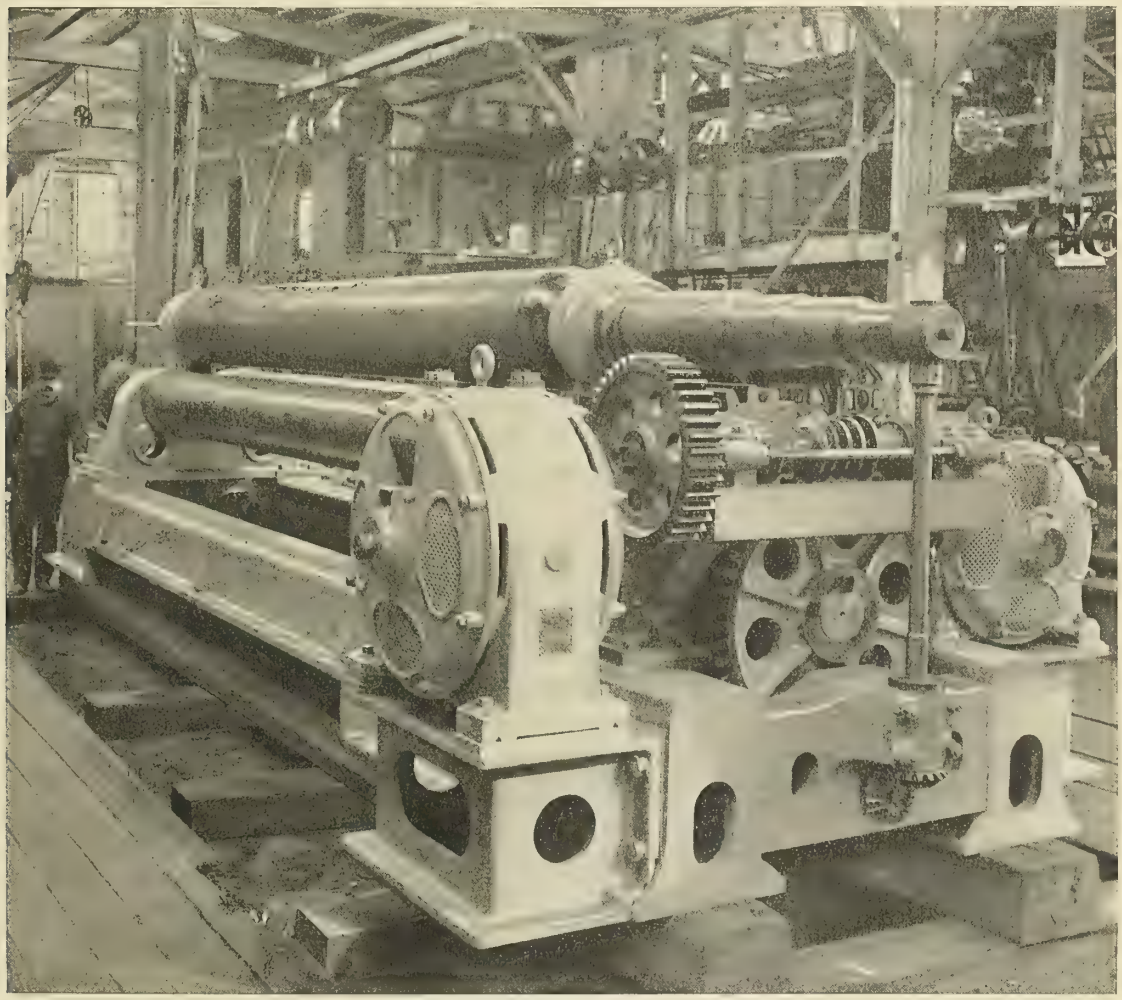
The principle of the expansion and contraction of metal is made use of in the line of standard thermometers manufactured for mechanical purposes by the Helios-Upton Company, Peabody, Mass. The fact



TYPE OF STANDARD THERMOMETERS.

that the expansion of metal is the same for each degree throughout ordinary ranges of temperature permits thermometers made on this principle to be most accurate in their readings. The indicator of this thermometer is actuated by the expansion or contraction of a bimetallic strip of metal called a lamina, which is coiled

upon a mandrel. This lamina is in the tube, as seen at the right hand of the cut, and is at such distance from the case and dial that it may be put through the shell of a boiler, through a hole drilled for that purpose, and allowed to come in direct contact with the liquid or vapor whose heat is to be taken. The temperature is recorded by the indicator hand, which travels around the enameled face. The instruments are held in place by substantial screws of regular pipe-thread size, so that the threads may be cut in the boiler by standard taps. When the instrument is thus screwed into position it is a permanent part of the boiler, and a perfectly tight joint is made around the stem. The advantages of this type of thermometer over the mercury-column instruments are, their accuracy after long-continued use, the legibility of their dials, and the slight cost of repairs.



MOTOR-DRIVEN PLATE-BENDING ROLLS.

Motor-Driven Plate-Bending Rolls.

The Continental Iron Works, of Brooklyn, have recently built and installed at their plant a new machine designed for bending heavy plates for boiler shells. The rolls measure 16 1-2 feet between housings. They are three in number and are composed of steel forged at the Bethlehem Works. The top roll, which is the idler, weighs 10 tons and measures 21 inches in diameter, while the two lower driven rolls are each 17 inches. In order to insure a sufficient factor of safety the designs, which were made by Mr. Warren E. Hill, vice-president and general manager of the Continental Iron Works, were for bending a 16-foot plate of 1 1-2 inches in thickness into a cylinder 5 feet in diameter, which it is needless to say far exceeds the demands that will ever be required of the machine.

In general appearance these rolls resemble others intended for similar work, but they nevertheless embody several distinctive features which may be noted. First, although these rolls are heavy and powerful, they are very compact and the gearing is so designed and arranged as to occupy comparatively little space. This feature is clearly shown in the accompanying cut, which is an end view showing the frame on which the motors are mounted and the arrangement of the driving gear. The motors are Westinghouse Type C variable speed and develop 40 and 50 horse power respectively. The larger motor drives the two lower rolls, and the smaller motor is employed to raise and lower the top roll. The motors take current at 220 volts, 7,200 alternations, and provide for a wide range of speed variation. They are

controlled by an operator stationed on a platform above the motors and gearing. A feature of this equipment that commends itself especially to the management is the fact that very little attention is required by these motors, that they are easily regulated and respond quickly to the varying demands for power as well as the variations in speed, and the positive action of the regulating mechanism. The speed is greatly reduced by the gearing, that of the driving mechanism being brought down from 840 revolutions per minute at the motor to 3 1-8 turns of the rolls. The top roll has an extension, shown in the cut, which exerts a counter strain when plates are being adjusted or unshipped. A vertical rod is connected to this tail piece, and is employed to adjust the position of the upper roll and to tilt it when unshipping. In this class of heavy work it is necessary to have a convenient arrangement for unshipping the shell after it has been bent, and to meet this requirement a special end bearing was designed for the upper roll, which can be readily unlocked and slipped off the roll, then lowered until it is entirely out of the way, thus permitting the cylinder to be withdrawn. When the shell has been removed this end piece is raised to its former position, slipped back over the end of the roll, locked in place, and the machine is ready for operation again. The lowering and raising of the end piece is controlled by hydraulic power. While this end piece is withdrawn the upper roll usually sags a couple of inches, but the counter strain is provided for at the other end, and the form of the free end is such that the supporting piece can be readily slipped back without any difficulty whatever.

Cable Steamer Colonia.

The largest steamer of the cable fleet, the *Colonia*, was recently launched from the shipyard of Wigham Richardson and Company, Ltd., and will soon proceed to the Pacific to lay the cable from Vancouver to Fanning Island in mid-Pacific, and thence carry the cable to New Zealand. The ship is one of the Telegraph Construction and Maintenance Company, whose project it is to complete the circle around the world of British-owned cables laid between points all of which are in British territory.

The *Colonia* is about 500 feet long, 50 feet beam and 39 feet deep, and at load draft has a dead weight carrying capacity of 10,000 tons. Four large tanks are built in her holds to carry 3,000 nautical miles of cable. The bow is overhanging and the stern elliptical. The necessary gear will be fitted at both ends for handling the cable. The spar deck is flush fore and aft and in the bridge house midships are located the officers' quarters. On the bridge deck is the captain's room and chart room, and above this is the boat deck on which is the wheel house. Farther aft is the deck house for the special requirements of the cable service, and directly aft is a large house containing the steering gear. The ship is to be propelled by two triple expansion engines at a speed of 11 1-2 knots when loaded. The deck machinery includes very powerful steam double cable gear and eight steam winches, all of which are driven by a horizontal winch boiler.

The above facts are taken from the *Engineers' Gazette*.

THE PROFESSOR ON SHIPBOARD.

Story of an Attempt to Combine Theory With Practice.

BY C. A. MCALLISTER, CHIEF ENGINEER, R.C.S.

CHAPTER XII.

The work of overhauling and repairs was continued the following day. As the Professor had seen enough of Para in his first visit ashore, he decided to stay aboard ship and look around the engine room again. Shortly after breakfast he donned his overalls and went below. He found a gang of men still adjusting the main bearings, and others employed cleaning up about the engine room. Going over to the evaporator, he looked through the manhole plate and saw one of the firemen doubled up like a jackknife and busily engaged in knocking the scale off the spiral coils. He inquired of the first assistant if that was the usual method of removing the scale, and was answered by the counter-inquiry of:

"Certainly; how else would you do it?"

To this opening the Professor replied that it seemed to him that as the coils from their very shape must be elastic, a sudden change of temperature would have the result of loosening up the scale and make it readily removable. He suggested that if steam was turned on the coils until they were as hot as they could be made, and then cold water turned on them from a hose, the effect would be to crack the scale.

"Another way would be," he continued, "to put on the manhole plates, turn on the steam until the coils and shell were thoroughly heated, then start the feed pump up as rapidly as possible so as to cause a more rapid inflow of the cool water; or, supposing you have a vacuum on the main condenser, open up the connection from the evaporator to the condenser, and open the bottom blow valve on the evaporator. This would cause a sudden inrush of the sea water and would result in loosening the scale. In either case I think you would find that a large amount of the scale would break loose and fall to the bottom of the evaporator, and that such as did remain on the coils would drop off by tapping them with a mallet or block of wood."

These methods appeared to the first assistant to be quite feasible, and he promised the college man that the next time it became necessary to scale the evaporator he would try one of them. As the man who had been working inside the evaporator came out to have a breathing spell, the Professor took occasion to look inside, and by means of the portable electric light, which he was much pleased to observe that the man had been using, he made a careful examination of the interior. He was quite surprised to see that at about the level of the water the shell of the evaporator was badly corroded, and the vertical braces were eaten away to about half their original diameter. Upon inquiry he ascertained the fact that the evaporator had been in use for a period of only two years. The first assistant also assured him that this rapid corrosion was quite common with that type of evaporators. This led the Professor to suggest that it would be economical in the end to use evaporators made of sheet Tobin bronze; he also said that the vertical braces could be done away with by using bumped heads.

"Of course," said he, "the bronze plates would cost much more than steel plates, but they would last indefinitely."

The first assistant then informed him that the latest practice with steel evaporators was to fit a soft patch belt around the inside of the shell about 9 inches above and 9 inches below the water line. If this patch is carefully sealed and cemented occasionally, he concluded that the life of the evaporator would be greatly prolonged. The Professor asked him if they ever experienced any trouble from foaming in the evaporator, and in reply he learned that at first much difficulty was met with from this cause, but it was finally found, after considerable experimenting, that the water should not be carried over 3 inches high from the bottom of the glass. If that amount of water was kept up steadily by carefully regulating the feed pump, foaming very rarely occurred.

The Professor saw that there were no baffle plates in the evaporator and that no dry pipe had been fitted. He suggested that a baffle plate fitted tightly around the circumference of the shell with a good-sized opening in the center would tend to prevent violent foaming.

"You may have noticed," said he, "that water boiling in an open vessel has a tendency to cling to and run up the sides, leaving the center depressed. The violent ebullition which takes place in an evaporator no doubt gives the water the same tendency, so you will see that a baffle plate would, in a manner, prevent this action. I suppose," he continued, "that you always test the water that you use for drinking purposes."

"Only by tasting it," replied the assistant.

"Well, that's a fairly good test," said the Professor, "but it is not always to be relied upon, as salt or other deleterious matter may exist in the water without its being perceptible to the taste. A sure method is to draw off a glass of the water and drop in a small quantity (four or five drops) of liquid nitrate of silver. If there is any salt in the water it can be instantly detected by the cloudy appearance caused by the chemical reaction of the silver nitrate with the sodium chloride, precipitating silver chloride. From a hygienic standpoint it is very essential that the drinking water should be as pure as it is possible to obtain it, but for make-up feed in the boilers it is not so important, and the evaporator can therefore be forced to its utmost capacity."

The chief engineer here walked up to where the Professor and first assistant were standing, and, after greeting his brother, said: "I suppose you two have settled the evaporator question to your satisfaction."

"Not at all," replied the Professor; "we have simply agreed that neither one of us knows very much about it."

"By the way," said the chief, "what was that you started to tell me about painting when you were down here yesterday?"

"Oh," said the Professor, "I was merely going to suggest that it would be a good idea for merchant vessels to adopt some such system as is now used on all naval vessels for painting the various pipes connected with the steam machinery. For example, steam pipes are always painted white, as they are usually covered with canvas. They might be, on merchant vessels, left unpainted without departing from the system. Exhaust pipes are also painted white, but they are distinguishable from steam pipes by the flanges at the joints; those for steam supply being painted black and those for exhaust painted red."

"Now," continued the Professor, "the water pipes are all painted green." ("Well, there's some sinse in that," muttered Barney to himself.) "The edges of the flanges on delivery-pipe joints are painted red and those on the suction-pipe joints are painted black. All pipes connected with the fire service are very appropriately painted red and have red flanges. Fresh-water supply pipes are painted blue and have black flanges, and discharge pipes are blue with red flanges. Flooding, drain, and flushing pipes are all painted pink and have pink flanges. This method, while primarily designed for convenience in tracing out the leads of the various pipe systems, is found to add materially to the appearance of the engine room. As the pipes are generally painted one color or another, the adoption of such a system on merchant vessels would not add greatly to the original cost of painting. Another good feature aboard naval vessels is the system adopted for labeling all valves, cocks, connections, etc. With the innumerable fittings of this kind that now constitute such important parts of modern steam machinery, some such system as this is not only very useful, but almost indispensable. To be sure, it is possible for a man to learn every valve and connection about a ship without their being marked, but it takes a very long time, I imagine, for him to master it. Take that manifold there, for instance; I suppose that in a couple of hours or so I could, by crawling all around the ship, lifting up floor plates, etc., find out just where each valve connected. On the other hand, how much simpler and better if the name of the compartment to which each suction valve connected was indelibly cut into the rim of the handwheel, or stamped on a brass plate secured opposite each valve on the bulkhead! Another useful indication is an arrow stamped on each handwheel, with the words 'to open,' so as to show which way to turn the wheel to open the valve. A few precautions like these tend to simplify matters about the engine room greatly, and make it possible for a new man to catch on to the lay of things without wasting a lot of time in studying them out."

The chief turned around and said: "Barney, how would you like such a system around here?"

That worthy replied: "Shure that would be too aisy; ivery granehorn that we shipped would soon know as much about things as any of us old hands."

The chief, however, admitted that there were some merits in the painting and labeling systems, as he remarked that on every trip he had a large number of new men to break in, and that frequently serious mistakes were made on account of the men not being familiar with the valves.

"Why," said he, "it was only last trip that one galoot was told to pump up the boilers, while we were at the wharf, with the auxiliary feed pump. I thought from the sound of things that something was wrong, and upon examination I found that the man had opened the bilge connection on the manifold instead of the valve connecting with the feed tank. Now, if those valves had

been marked as you suggest such an incident would not have happened."

The Professor, encouraged by his brother's commendation, went on to suggest that the arrangement of tools could be systematized so as to avoid the necessity of delay in hunting them up in case of emergency. "You should have all wrenches for use around the top of the engine arranged in a neat wrench board secured to one of the bulkheads within easy reach. Each wrench should have stamped on it the purpose for which it is intended. In the lower engine room the wrenches for your main bearing bolts and crankpin bolts should be hung up in a rack convenient to the engine and each one stamped. By such arrangements the wrenches would always be in accessible places, and if they became mislaid their absence from their proper places in the racks would soon attract the attention of one of the engineers. If I were a seagoing engineer I think I would pay a great deal of attention to the tools used for overhauling, as I can readily see, from the experience I have had on this trip, that a great deal depends on having the proper tools on board ship and knowing just where to put your hands on them."

It was now about 3 o'clock in the afternoon, and, as all the overhauling was completed, preparations were being made to get under way again. In putting away the tools, etc., which were used in adjusting the bearings, the Professor noticed that the caps had evidently been lifted by two dirty old rope tackles. This led him to remark that it would be very much better to have a couple of small differential hoists for the purpose.

"It seems to me that there is too much grit and dirt hanging on to that old rope to make it advisable to use around bearings. If you use chain tackle they can be easily kept clean and you don't have to bother with making the end fast every time they are used."

"Those things are too expensive for our company to furnish," replied the chief. "The superintendent would have a fit if I asked him to buy such gear."

As the ship was to sail early in the evening, the Professor washed up and togged himself out in a clean white duck suit. As he sat out under the awnings he looked out toward the ocean and inwardly prayed that no more tropical squalls might come up during the remainder of the voyage. On the run down to Rio Janeiro the weather turned out to be very fine, and the trip was made without incident worthy of note. The ship spent about a week in that port, as it was the end of her run. The Professor spent several days ashore, and enjoyed visiting the various places of interest very much indeed. He took occasion to purchase a number of curios for his friends at home, and in doing so he would involuntarily count the number of days before he would be able to deliver them. When sailing day finally came, with a whole lot of new passengers to study and get acquainted with, there was no happier man on board than the Professor. His one object now was to get home and get as far away from a ship as possible. Had there been an intercontinental railroad in operation at that time there is no doubt but that he would have returned by rail.

On the morning after the ship sailed the Professor did not put in an appearance at the breakfast table. When the chief missed him he went to his room and found his brother lying in his berth suffering with a high fever. Whether it was due to the water he drank on shore or to the spirits that he did not drink will never be known; but at all events the Professor was a very sick man. The ship's doctor was immediately summoned, and at first was inclined to think that he had a genuine case of yellow fever on his hands. Later developments proved that it was not that dread malady, but a severe case of malarial fever. For days the sufferer was confined to his room, and at times was delirious from the fever. Every attention was given him by the officers of the ship, and even old Barney would spend much of his time off watch in his state room, where he would alternately fan him and tell him stories to cheer up his drooping spirits. When the ship got off Hatteras the Professor had so far recovered that he was able to sit out on deck and enjoy the cool breezes which now were encountered. The thought of being so near home proved to be a better tonic than any that the doctor had given him, and by the time Sandy Hook was reached he was able to walk around without assistance.

When the vessel finally reached the wharf the Professor, now more emaciated than ever, went around and bade all the engineer's force good-by and thanked each of them for the attention they had given him. Remembering his kindness in giving them the money he had won at Para, the hearty grips given him by these lusty fellows were enough to make him wince. After he had gone they all agreed that he was, as one of them expressed it, "a domnd good fellow." The Professor had obtained the chief's permission to take old Barney back to the college with him, where he obtained a position for the oiler as chief engineer of the steam-heating plant at a salary of $75 per month. As the Professor was so weak after his illness, his brother accompanied him home to the college town. As the term did not begin for three weeks yet, the Professor went up to a mountain resort, where he rapidly regained his health. In ruminating over his experiences on shipboard he made up his mind that the place for a theoretical man is on shore, and that practical men would be much better off if they had a little theory combined with their practical knowledge.

(The End.)

New Turbine Yacht.—The new steam yacht *Revolution,* which has just been built and equipped with Curtis turbines, is reported to have beaten the Sandy Hook steamer *Monmouth* in New York harbor the first of last month. This is the first vessel to be equipped with successfully operating turbines in this country.

Prize Contest.—The Council of the Society of Naval Architects and Marine Engineers, 12 West Thirty-first street, New York city, is authorized to offer a prize, not exceeding two hundred dollars in value, for the best paper upon some subject directly pertaining to naval architecture or marine engineering. The papers submitted in competition for the prize must be sent to the secretary before October 1, this year, and should be plainly addressed and marked, "For prize competition." The prize offered at the last annual meeting evoked such valuable papers that it has been wisely deemed to make a similar offer this year.

Heaving Down Whaleships.

Editor of Marine Engineering:

The article in your issue of February, regarding the manner in which whaleships used to be "hove down" for calking and coppering, takes me back to the days when several hundred whaleships hailed from this harbor. There were three good reasons why it was customary to "heave down." In the first place there were nowhere near enough marine railways to go around, consequently it was necessary in most cases to resort to some other means. In the second place it was a cheaper method of doing the work.

Probably the most important reason was because there was more or less strain on the ship, and the seams were opened a little so that the oakum could be driven home to better advantage. You, of course, know that the whaleships in those days usually went off on voyages of four or five years, and if they were

DECK SCENE DURING BOILING.

VIEWS ON A WHALER—SCRUBBING WHALEBONE.

calked when hauled out on a marine railway, it was more or less of a question whether the calking would hold out during the entire voyage; but if the calking were done with the ship "hove down," the calking would, in all probability, outlast the voyage and the ship be much tighter.

Your readers, perhaps, will be interested to see two pictures which illustrate life on a whaleship. The first picture is a deck scene during the "boiling." The two men in the foreground are "mincing" blubber, and the man at the left is towing a bucket of minced blubber around to the other side of the try works. There is so much steam arising from the try works that nothing can be seen in the picture except the two smoke stacks indistinctly. After the oil has been boiled out of the blubber, the "scraps" are skimmed out of the try pots and put into the press shown near the left of the picture. The press is represented as open, and the screw is shown which is used to give a final squeeze to the scraps so as to secure the last drop of oil. At the extreme right is the cooper, who is drawing the oil off from the cooler ready to transfer it to the casks so that it can be stowed in the hold.

The other picture is a deck scene when the crew are washing the whalebone. In the background are the two big deck pots, where the "bone" is immersed in boiling water, then, slab by slab, it is laid out on planks as shown in the middle of the picture, where three men can be seen scrubbing a slab.

It is so many years since any whaling of any consequence has been done in New Bedford, that it is now a very rare occurrence for a whaleship to sail from this port.

New Bedford, Mass. Fairhaven.

Oil Lubricated Tail Shaft.

Editor of Marine Engineering:

I have read with much interest the several articles in Marine Engineering on the galvanic action of the tail end shafts, and well realize what vital parts of the ship the stern tube and tail shaft are. But how little we know of what is going on inside that tube; it is lucky sometimes that we don't know or we would be liable to jump off at the first port. In some first-class companies which I have sailed for they make a rule of examining the tail shaft every year, but how many steamships are there whose tail shafts are never examined until they have a warning of something wrong? Galvanic action going on inside the tube or under the brass liners gives no warning.

I can see a shaft now which came out of a steamer bad enough to make one's blood run cold at the thought of being at sea with a tail shaft in such condition. It certainly would have been condemned long before it got in such a state, but no one knew anything about it until the propeller broke and had to be replaced by a new one, when the shaft was examined. By the breaking of that propeller the ship and lives of those on board may have been saved. If brass, rubber or gutta percha liners are put on the shaft we certainly cannot tell what is going on under those liners until they are taken off, and very few steamship owners will consent to that.

Mr. Editor, I wish to ask you and the readers of Marine Engineering what is wrong with a tail shaft turned up and polished all over with two bearings slightly larger in diameter than the rest of the shaft, these bearings to work in babbit instead of lignumvitae, the cast iron stern tube to be tapped in the center for a pipe say one inch or so in diameter, the pipe led into the shaft alley and connected with a compression grease cup which is worked by a pawl and ratchet from the main shaft and is regulated to keep a pressure on the tube greater than the outside water pressure, so that no water can get in. There being no brass, copper or salt water inside the tube the galvanic action will be reduced to a minimum, the shaft will be easy to examine when drawn, and being polished the least flaw can be noticed. Marlin Spike.

Page's Magazine.—In the month of July, 1902, the first number appeared of *Page's Magazine*, which, according to the statement of the editors, is to be devoted to engineering, shipbuilding, iron and steel, electricity, and mining industries. It is published in a very handsome style, 8 by 21 inches in size. As stated in the introduction, the above-mentioned industries have been chiefly responsible for the remarkable advance of the present age, and it will be the purpose of the magazine to bring these subjects before the public in a comprehensive manner. It is stated that the magazine will be an "essentially English production with the advantage of American ideas and methods, which will be pressed into service in just those directions in which our experience has shown that they are desirable." It is just these American ideas and methods of publishing a magazine which will so highly recommend it, if its artistic and literary merits continue to be as excellent as the first specimen. The articles therein contained include Naval Notes from the Powers, well illustrated with views of battleships; sketches of James Swinburne and C. T. Yerkes; then comes a monthly *résumé* of the various mechanical industries of the world. Next is an article on the Developments in Cyanide Practice, following which are Locomotive Engineering Notes. The Glasgow Tramways are well described and illustrated; then follows an article on Milling Machines, both English and Foreign. A department which will probably develop with age is that of Workshop Practice. The succeeding pages are devoted to articles on Iron and Steel Manufacture, Prime Cost, Business System and Organization, the Modern Foundry. A review is given of the notable British papers of the month and several live topics are taken up. An attempt is made to review some of the Continental papers, and the closing sections are devoted to Correspondence and the books of the month. The editorial pages for this month are 128 in number, which is a remarkably good showing for a new magazine. The field to which the paper is to be devoted is, indeed, an extensive one, embracing the entire mechanical world, and the only criticism that may be forthcoming is that too much has been attempted and that, therefore, but small space can be devoted to any one subject. The editorial and publishing offices are at Clun House, Surrey street, Strand, London, W. C., and the International News Company, New York city, will receive American subscriptions. The subscription price is 37 cents a copy, or $4 a year.

TECHNICAL PUBLICATIONS.

Self-Propelled Vehicles. A practical treatise on the theory, construction, operation, care and management of all forms of automobiles. By James E. Homans. Size 6 x 8 3-4 inches, pp. 632, with 466 figures in the text. Price $5.00. New York, Theo. Audel and Company.

The purpose of the publishers in bringing out this book has been to meet the increasing demand for a thorough treatise on the subject, in the belief that such a work cannot fail to have value to the ever-increasing number of those who are becoming interested in the automobile, either as users or builders.

This field of engineering work is somewhat peculiar, in that it involves the interests of so many persons who lack previous acquaintance with engineering matters of all kinds, and in consequence the style of treatment called for is peculiarly simple and somewhat more detailed and elementary than would be otherwise required. The author has, therefore, introduced an elementary presentation of the theory and operation of steam boilers and of steam and gasoline engines and of the electric motor. The discussion of the gasoline engine is especially noteworthy, and it will be found of interest and value to all concerned with this type of motor, which is becoming as firmly fixed in the marine field for the operation of small boats as for the motive power in the modern automobile.

The book as a whole takes up the matter first from the historical standpoint, followed by a discussion of the modern motor vehicle, with a description of its parts and a discussion of the principles involved in its operation. Following this are given in detail descriptions and discussions of the various methods and means of powering such vehicles, steam, gasoline, and electricity.

The discussion of the various parts of the modern gasoline engine, both of the two-cycle and four-cycle types, is especially full and should be of great value to those concerned with machinery of this type. Chapters are given on the general principles of gas-engine operation; on the methods and conditions of gas-engine cylinder cooling; on gas-engine efficiency and on estimating the horse power of gas engines, as well as descriptive of the various parts of a modern gas engine, their mode of operation and derangement to which they are subject.

The book closes with general hints and advice regarding the operation and management of motor vehicles of the various types.

The book is finely printed and the illustrations are profuse and, for the most part, excellent in execution. The purposes held in view, both by the author and publisher, seem to have been well realized, and the book may be recommended to all interested in motor vehicles and their management, while the general chapters on the gasoline engine will be found of value to the far wider range of readers who may be interested in motive power of this character.

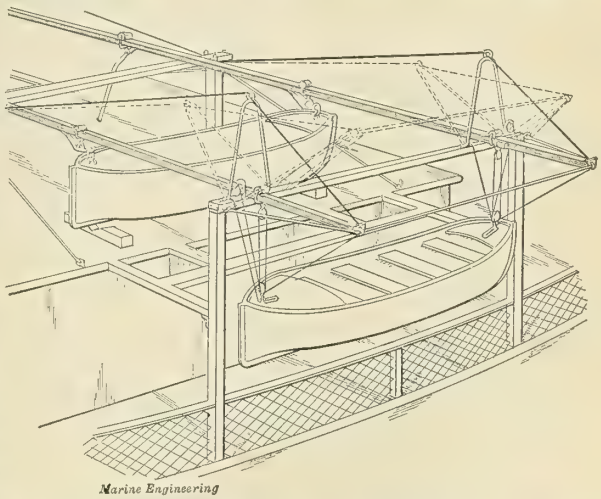
Notes on the Construction and Working of Pumps. By Edward C. R. Marks. Size 5 by 7 inches, pp. 187, with 117 cuts. Price three shillings sixpence. London, The Technical Publishing Co.

The author of this book states that it has been prepared for the user of pumping machinery rather than for the designer or maker, and he has in consequence considered the leading styles of pumps and pumping engines as the user receives them and in the finished state. The earlier chapters, however, deal with a variety of topics relating to pumps in general and to the principles involved in their operation. In the later chapters the various types of pumps and pumping engines actually on the market are taken up and described, with some discussion of their peculiar characteristics or suitability for various classes of work. Naturally the illustrations are drawn from British practice, and while therefore the book will be of much interest to all engineers concerned with pumping machinery, its special value will be rather for those whose practice leads them into contact with machinery of British construction. Since, however, the principles are throughout the same, and since the same general topics are met with on both sides of the Atlantic, and to some extent the same actual makes of pumps, the American reader will find in this book much that will be to his direct aid in connection with the installation and operation of pumping machinery of all types. The descriptions seem to be clearly written, the types well chosen, and the illustrations such as to supplement the text sufficiently for the purpose in view. The book is one which may be recommended to all who are interested in this field of engineering work.

SELECTED MARINE PATENTS.

700,408. TIDAL MOTOR. RICHARD W. DERBYSHIRE, DAGENHAM, ENGLAND.
Five claims.

701,009. LIFEBOAT LAUNCHING DEVICE. JAMES W. BEDFORD, SAN FRANCISCO, CAL.
CLAIM.—1. In a launching apparatus, the combination with track-rails, and supports therefor, of a trolley device mounted upon said rails and including a pivoted elevating member normally disengaged from the boat, and adapted to engage and suspend the boat.



Marine Engineering

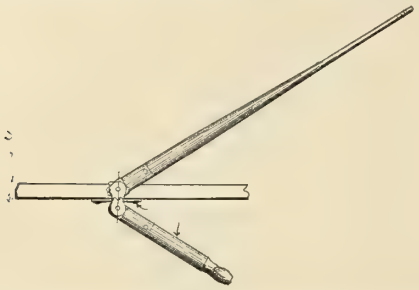
2. In a launching apparatus, the combination with track-rails having hinged sections at the ends, and supports for said rails, of a trolley device to travel on the rails, and a swiveled lifting device normally attached to the trolley, and disengaged from a boat and adapted to engage and elevate the boat and suspend it.
Eight claims.

701,329. AUTOMATIC SELF-INFLATING LIFE-PRESERVER. JAMES GRAHAM, CARNOUSTIE, AND ROBERT R. TATLOCK, STIRLING, SCOTLAND.
Four claims.

701,595. FEATHERING PADDLE-WHEEL. JAMES MERKEL, WELLERSVILLE, OHIO.
Twenty claims.

701,759. OAR. KNOWLTON C. McNEILL, CHANDLERSVILLE, ILL.

CLAIM.—1. The combination with a rowboat of an oarlock comprising an inwardly-turned hook secured to the inner surface of the side of the boat, an oar comprising two sections having a gear connection and plates between which the gears are supported, one of said plates having depending ears connected by a cross-rod engaging under the hook. Two claims.



702,129. CONTROLLER FOR PROPELLERS. WILLIAM COOPER, DENVER, COLO.

CLAIM.—2. In steam-driven vessels, the combination of a propeller; a horizontal cylinder in the hull of said vessel open to its full diameter to the sea at a point in the stern of said vessel adjacent to said propeller; a piston reciprocating in said cylinder and acted upon in one direction by sea-pressure and in the other direction by mechanical means; boilers; propelling engines; a steam line connecting said boilers and said engines; a valve in said steam line; an exhaust on said steam line between the boilers and said valve and coupled with said valve, and means whereby said valve is operated by the movement of said piston in said cylinder. Three claims.

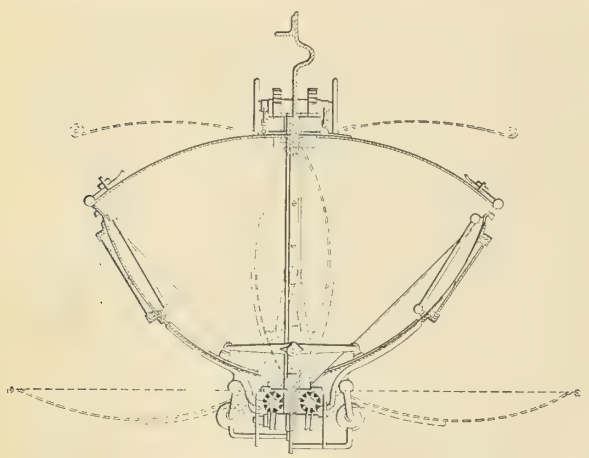
11,999. REISSUES. STEAM TURBINE. JOHN BURGUM, RIO JANEIRO, BRAZIL. FILED DEC. 26, 1901. SERIAL NO. 87,239. ORIGINAL NO. 641,074. DATED JAN. 9, 1900.

CLAIM.—1. The combination, in a steam turbine, of an external fixed cylinder and an internal revolving drum, having their interior and exterior surfaces provided with a series of longitudinal steam-directing blades, and a series of transverse steam-directing partitions intersecting said blades; the blades and partitions terminating centrally between the ends of the cylinder and drum to provide a central annular steam chamber, and the outer edges of said partitions being substantially in line with the outer edges of the blades. Five claims.

702,399. LIFEBOAT. LEMUEL BROWN, SAUGATUCK, MICH.

CLAIM.—1. A lifeboat comprising a central compartment and end sections, a false bottom, a pivotally-mounted floor section in the form of an auxiliary boat suspended from above and above the false bottom, and means for adjusting the height of said floor section and allowing it to rock to compensate for the rocking movement of the boat. Two claims.

702,651. BULKHEAD DOOR. WALTER W. IFE, BUFFALO, N. Y.



CLAIM.—1. In a bulkhead doorway, in combination, a pair of similar, interconnected doors positioned at substantially a right angle with each other and both hinged to the same door jamb, a concave casement upon the opposite jamb within which the free edges of said doors oscillate and closely fit, and sealing devices, the bulkhead co-operating with either door when in closed position. Fifteen claims.

702,705. FLOATING DREDGE. EPHRAIEM CHAQUETTE, NEW ROCHELLE, N. Y.

CLAIM.—1. A floating dredge, provided with a longitudinal channel therethrough with its ends enclosed, a dredge carriage moving on a suitable track extending along said channel near the water line, a chain-bucket dredging apparatus and its operating mechanism supported on and carried by said carriage, and a dumping-apron car adapted to receive material from said chain-bucket dredge and convey it to the discharging apparatus, substantially as described. Two claims.

702,728. SUBMARINE BOAT. JOHN P. HOLLAND, NEWARK, N. J., assignor to Electric Boat Company, a corporation of New Jersey.

Two claims.

702,965. FLOATABLE CAISSON FOR CLEANING SHIPS' SIDES AND BOTTOMS. ROBERT KAUCHER, ROCHESTER, N. Y.

Four claims.

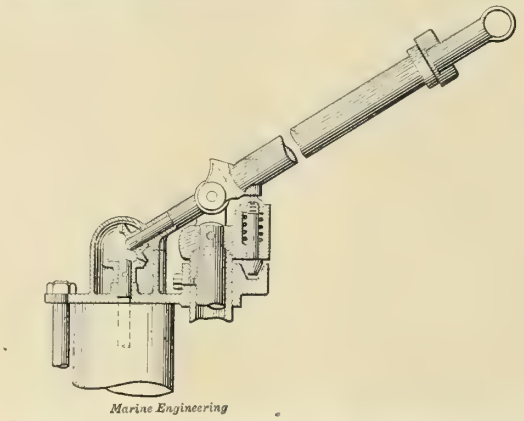
703,139. STELLAR COMPASS AND GREAT CIRCLE-COURSE PROJECTILE. ROBERT T. LAWLESS, ALAMEDA, CAL.

Eleven claims.

703,181. MARINE PROPELLER. CARLOS CONSTANTINO DA ROCHA CARVALHO, LISBON, PORTUGAL.

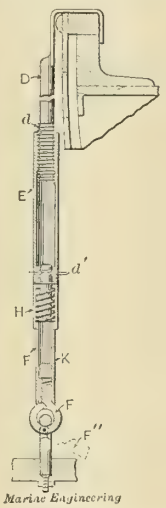
Four claims.

703,552. STEERING GEAR. WALTER A. CROWDUS, CHICAGO, ILL.



CLAIM.—10. In a steering gear, the combination of a fixed support, a steering post revolubly mounted therein, a head on said steering post, a steering lever pivoted to said head, a lock bolt mounted in said head beneath said steering lever and adapted to be depressed thereby, a groove in the fixed support in which said steering post is mounted adapted to be engaged by said lock bolt, said lock bolt and groove being correspondingly tapered, and a spring applied to said lock bolt and adapted to maintain the same normally retracted. Ten claims.

703,664. BOAT LASHING DEVICE. SWEN NILSON, BOSTON, MASS.



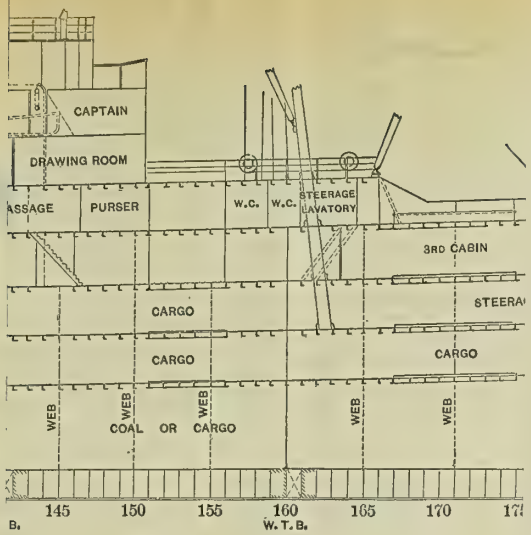
CLAIM.—1. The herein described boat lashing device, consisting in combination of a hooked screw-threaded rod *d*, *d'*, *D*, an adjustable internally-screw-threaded sleeve *E*, a hooked rod *F*, rotatably connected to said sleeve, and provided with a pivoted latch *F''*, a sleeve *H*, secured to the upper end of the rod *F*, and a longitudinally-adjustable spring-pressed latch holding sleeve *K*, substantially as and for the purpose set forth. Two claims.

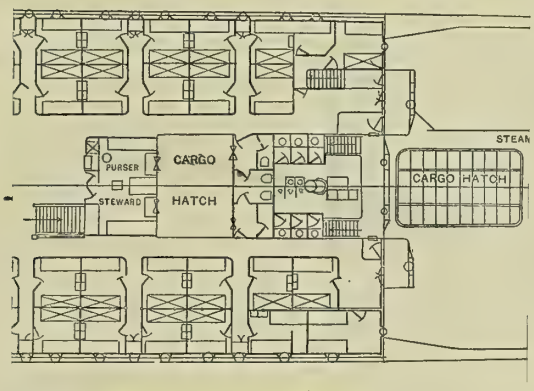
703,713. SAFETY RELEASING DEVICE FOR THE SHEETS OF BOATS, TOW LINES, ETC. CHARLES SMITH, SOUTH CROYDON, AND GEORGE J. HONE, ROMFORD, ENGLAND.

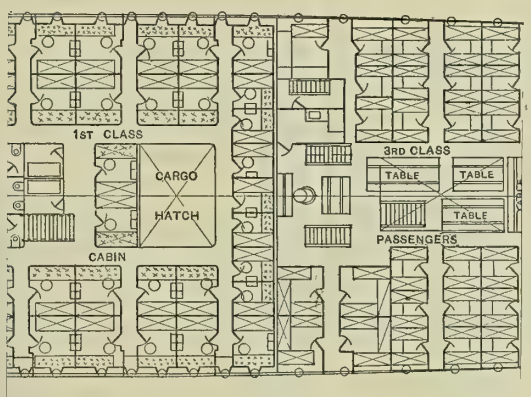
CLAIM.—1. A device for holding and for automatically releasing the sheets of boat sails, tow lines, and other connections, upon the application of a predetermined amount of force. Five claims.

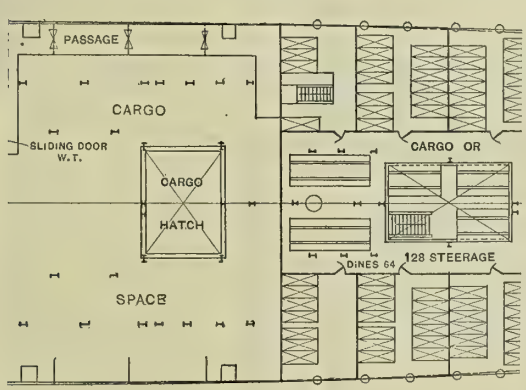
703,739. ANCHOR. JACOB E. RECH, PHILADELPHIA, PA.

One claim.

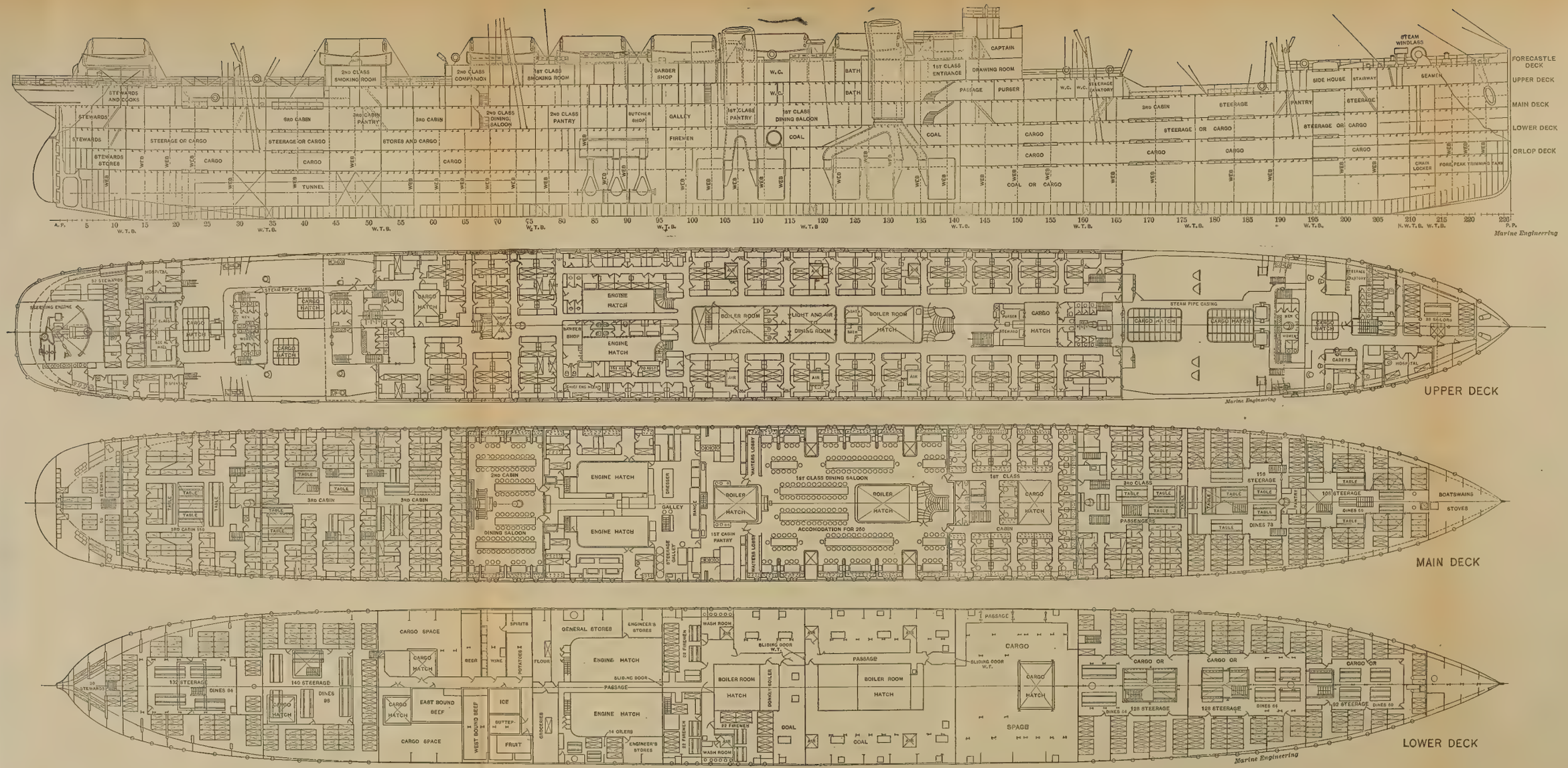




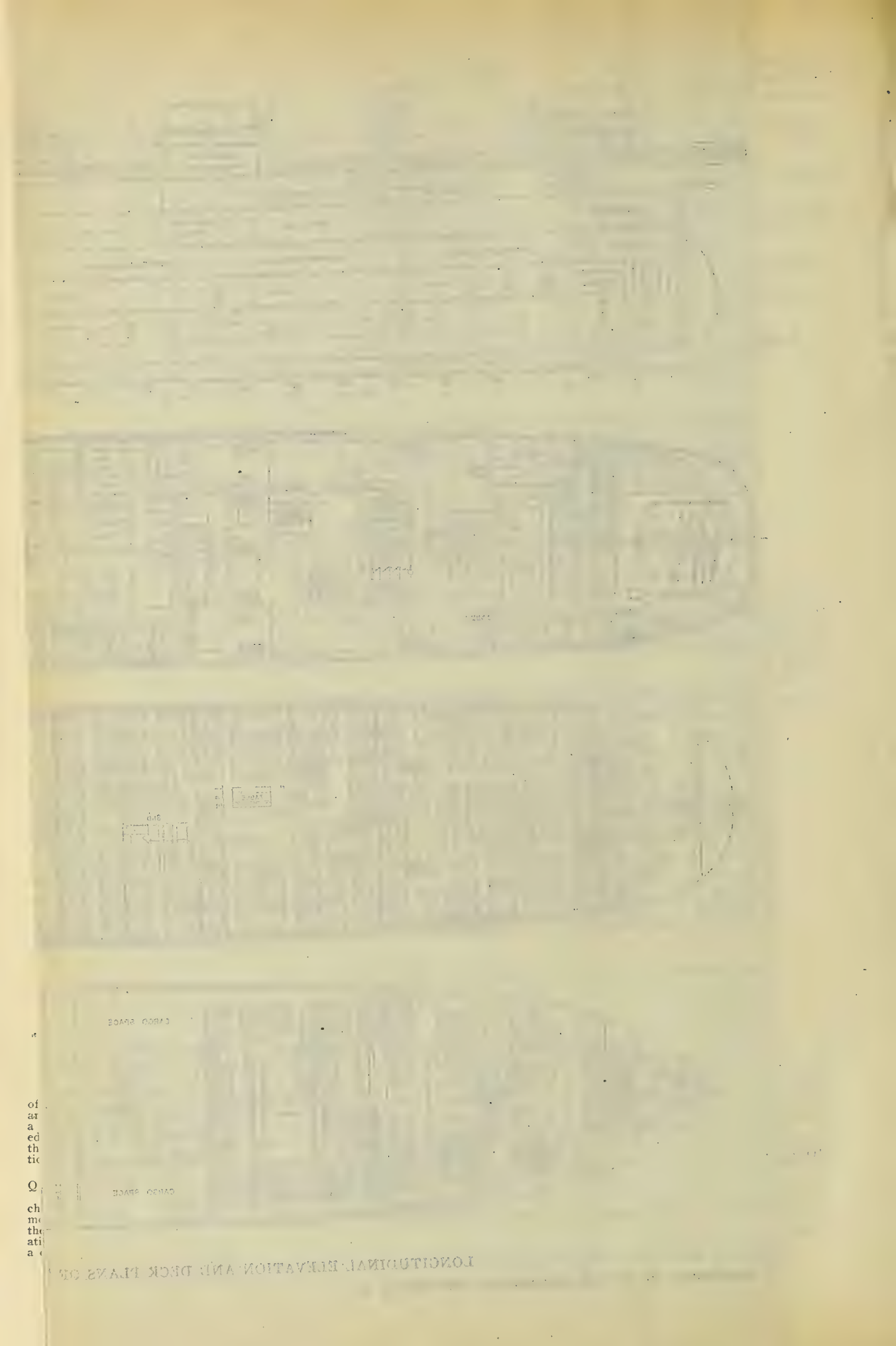




.BUILDING COMPANY, FOR THE INTERN/



LONGITUDINAL ELEVATION AND DECK PLANS OF THE STEAMSHIP KROONLAND, BUILT BY THE WM. CRAMP AND SONS' SHIP AND ENGINE BUILDING COMPANY, FOR THE INTERNATIONAL NAVIGATION COMPANY.



INDEXED.

Marine Engineering

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NEW STEAMSHIP KROONLAND OF THE INTERNATIONAL NAVIGATION COMPANY.

The twin-screw steamship *Kroonland,* which is the latest addition to the fleet of the Red Star Line of the International Navigation Company, is in many respects a remarkable vessel. She is the fifth new ship built for the International Navigation Company within a year, and is the largest ship yet built in America.

RED STAR LINE STEAMSHIP KROONLAND.
(Copyright, 1902, International Navigation Co.)

In this vessel the Messrs. Cramp, from whose shipyard she was launched in February of this year, have established many records. The time elapsed from the date of the launch until the date of sailing on the first voyage was four months, which indicates the resources of this famous shipyard for rapid work.

The *Kroonland* presents several novel features in design, but the most noteworthy fact is this—that in her the builders have solved the difficulty of riveting a large ship throughout by machine tools. Experience with many recent ships of large size has shown that the best hand-driven riveting is insufficient to meet the demands made by the Atlantic service for closeness and soundness of work. The ships are now so large that the stresses brought upon them by Atlantic weather are very great, and nothing but machine riveting can develop the strength which is provided by the heavy material used in the structure. The problem presented to the Messrs. Cramp was how to adapt pneumatic power tools to deal with intricacies of shipwork. The impossibility of adapting hydraulic power tools to such work had long before been proven; and although many parts of a ship hitherto considered beyond the reach of hydraulic tools had been successfully riveted by improved hydraulic riveting tools, it was manifestly impossible to get such tools made suitable for application to all parts of a ship. The builders, therefore, turned to pnuematics, and by the aid of one of the prominent pneumatic-tool companies the required tools were produced and existing tools were adapted to work which, until then, had been considered beyond the scope

(Copyright, 1902, by Marine Engineering, Inc., New York)

of pneumatic appliances. As the *Kroonland* began to grow, so did the needs for new and varied tools; and as the needs became urgent they were met, until not a rivet in the hull could be considered too difficult for pneumatic tools to deal with. The result is that this ship is almost entirely pneumatic riveted, the hand-driven rivets being very few and far between and consisting only of odd rivets.

During construction this vessel was visited by some of the most prominent shipbuilders of Great Britain, who expressed their admiration for the methods and tools used and for the results obtained.

One of the interesting features of the design is the main deck; the state rooms are on the main and upper decks; and the special state rooms, smoking rooms, and drawing rooms are on the promenade deck.

The decorations of the first-cabin public rooms, which were designed by Messrs. Waring and Gillow, of London, have been well carried out by Messrs. Cramp. The first-cabin dining saloon is finished in white, Adam's style. It is seated for 250. A large dome skylight of decorated glass occupies the center of the ceiling, and is illumined at night by the electric lights above. The furniture is of inlaid mahogany. The drawing room is also white, Adam's style. It is paneled in green silk and furnished with inlaid satinwood tables, chairs, and

DECK VIEW, STEAMSHIP KROONLAND, LOOKING AFT ON PROMENADE DECK.

use of the long bridge house as a main part of the upper structure instead of making it a mere superstructure. It is said that the American type of steamer is flush-decked, and that all steamers built in America should be flush-decked; but it is a pity to limit American shipping to one type of ship, because different trades require different types; and, after all, commercial utility should decide whether a new ship is to be flush-decked or not. Suffice it to say that the *Kroonland* is not flush-decked and that the superstructure is made a main part of the hull.

The chief features with regard to the size of the ship are given in the appended tables.

The first and second cabin passenger accommodations are amidships. Both dining saloons are on the settees. This room opens into the main companionway, which is framed and paneled in mahogany. The main stair leads from the promenade deck to upper deck, and from upper deck to first-cabin saloon. All the stairs in the first cabin are mahogany, with mahogany rails and balusters and white rubber treads.

At the end of the first-cabin house on promenade deck the first-cabin smoking room is placed—a large room finished in Elizabethan style, from designs by Messrs. Waring and Gillow. The sides and beams are fumed oak, the ceiling panels are buff, and the large central skylight covering the greater part of the room is glazed with ornamental leaded glass and decorated in bold Elizabethan relief. The upholstery is red-stamped leather, and deck is covered with American rubber tiles.

All the first-cabin accommodations on the promenade deck are within the deck house, which is 195 feet long. In ships of the size of the modern transatlantic liner it has been found impossible to maintain a long house on the uppermost structural deck without great annoyance to passengers from leaks, and without considerable expense to the shipowners repairing the fractures which from time to time, as the voyage is more or less stormy, appear in the sides and top plating of such houses. It is the usual practice with those who try to avoid these troubles to cut the promenade deck house into sections, quite apart, leaving passages of at least a beam space between them. This interferes greatly with the arrangement of the ship, and causes inconvenience to passengers and loss of efficiency in the steward department of the ship. But it is the practice of the owners of the *Kroonland* to maintain the long promenade house, and yet avoid the troubles above mentioned, by fitting at intervals a flexible joint in the house, a device designed by a member of their technical staff several years ago and successfully used on all their larger ships. By this means the strains on the house are localized and prevented from disturbing the sides or top of the house.

The second-cabin promenade is railed off from the first-cabin promenade on the same deck. On it the second-cabin passengers have a large companionway, a ladies' room, and a smoking room. The companionway is in oak and is fitted up with lounges handsomely upholstered. The ladies' room opening off the companionway is finished in maple. The smoking room may be reached from the deck below by stairway from the main passage or from the promenade deck at the after end. This room is finished in mahogany and is handsomely furnished and upholstered in brown leather. The deck is laid with rubber tiles.

All the houses on promenade decks are lighted by Mullan's patent square light with ventilator on top. These lights are probably the best deck-house ports to be had. They combine the maximum of opening with the greatest security from leaking. There is, however, no need to open ports on the *Kroonland,* two complete systems of ventilation, the one supplying and the other exhausting air, being fitted throughout the accommodations for cabin passengers, after steerage passengers, and crew. To this we shall return shortly.

LAUNCH OF THE KROONLAND FROM THE YARD OF WM. CRAMP AND SONS' SHIP AND ENGINE BUILDING COMPANY.

All the first-cabin state rooms are painted white enamel, furnished with mahogany, and upholstered in tapestry or moquette. All the large state rooms have a double and the others a single wash cabinet of improved design, with folding table attached. The berth fittings, including racks for clothing, etc., are nickel plated, and every room has a large number of nickel-plated hooks, sponge racks, etc. The upper berth folds up, and in many cases the lower berth folds out to form a double-width bed. All the ports are fitted with spring

shades, and the deck is covered with velvet pile carpet in the state rooms and passages.

The International Navigation Company has always made the second-cabin accommodations a special feature of their ships. In the *Kroonland* this practice has been well maintained. The second-cabin state rooms are similar to those of the first cabin, except in details, such as the folding beds, upholstery, and carpets. The second-cabin dining saloon, ladies' drawing room, and smoking room are fully up to the standard set in the *St. Louis* and the *St. Paul.*

There are two classes of steerage passengers—third class and steerage. The third class are located in the separate rooms for the petty officers and engineers. The captain and officers occupy the large house on the boat deck at the flying bridge, and the chart room and wheel house are on the bridge itself. Access to the bridge is sheltered by steel screens.

On the boat deck, which is carried along abreast of all the houses on the promenade deck, the life-saving appliances, in the form of boats and rafts, are fitted in number and capacity beyond the requirements of the American, British, and Belgian laws. Instead of the usual wooden boat chock, Wilson's patent collapsible boat chocks, supplied by the James Reilly Repair and Supply Company, are used. The boat is quickly freed

FIRST-CABIN SMOKING ROOM, STEAMSHIP KROONLAND.

Nos. 3, 5, 6, and 7 compartments of the main deck, and the accommodations provided consist of state rooms with folding beds, seats, mirrors, etc. Large dining tables with hardwood settees are fitted, and four pantries with hot tables, boilers, and all the usual fittings of a ship's pantry are provided. In each steerage companionway the lavatories and closets are placed. Solid porcelain bath tubs are provided, and all the lavatories have porcelain basins, with hot and cold water. The third-class quarters are ventilated mechanically.

Accommodations for the crew of 260 men are fitted under the forecastlehead, under the poop, and on the main and lower decks aft. Lavatories and shower baths are fitted for the stewards, sailors and firemen, with

from these chocks by pulling a lever, the mechanism not only freeing the boat and leaving it hanging, but also turning down the chocks on the deck. A boat winch with double drums for hoisting the boats is fitted on the boat deck, and the davit falls can be led to this winch through fairleads placed on deck at the davit and thence by way of lead blocks. The auxiliary boats are placed on rolling skids, which, when the boat under davits has been lowered, carry their burdens of Chambers' collapsible boats under the davits.

Besides the life-saving appliances the ventilating and heating apparatus is placed on the boat deck. A double system of supply and exhaust is fitted. One set of Sturtevant electric fans delivers fresh air through steam

coils to air ducts leading through the ship, and another set of fans exhausts the air from ducts brought from each state room and other space. Air is delivered in the passage alcoves and public rooms and is exhausted from the state rooms, public rooms, etc. The capacity of the apparatus provides a change of air every fifteen minutes.

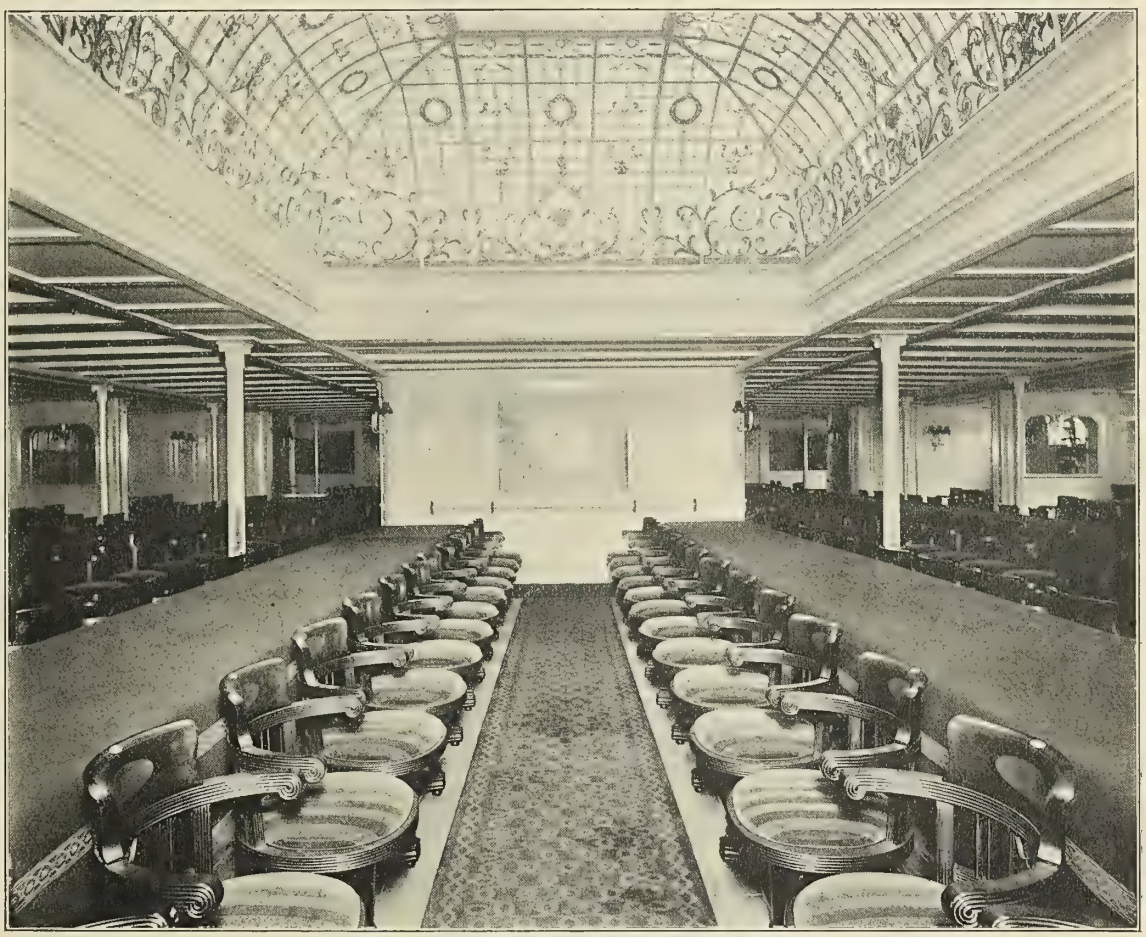
The sanitary system is very complete. There is a hot as well as a cold-water service, with separate pumps and delivery pipe to reservoir tanks on the boat deck, and distributing pipes thence throughout the ship. In addition to the fresh-water system, supplied from the six large storage tanks in the after holds through the fresh-water pump in the engine room, there is a complete condensed-water system with separate pump, supplying the reservoir tank on boat deck and led forward and aft to steerage and crew lavatories.

The ship's store rooms are on the lower deck, and include separate refrigerator rooms for meat, vegetables, and fruit, butter and milk, beer and ice, besides large rooms for groceries, barrels, potatoes, and general stores.

Structurally the *Kroonland* is interesting. There are four complete hull decks and the promenade deck, which runs for more than half length amidships. The forecastle deck is 88 feet long and the poop is 65 feet. The boat decks are light but substantially built above the promenade deck. All these decks, except the boat and orlop decks, are completely steel plated, and all are laid with wood. The beams are steel channels on every frame, with three rows of stanchions and channel ties. In addition to the four decks, web frames spaced 12 feet, except in the machinery space, are fitted all fore and aft. In connection with the webs two deep hold stringers are fitted between the webs, to which they are united by large diamond plates and double angles. Special attention has been given to the forward framing to prevent panting, where additional webs, breasthooks, and stringers are fitted.

The ordinary frames are channels, and extend from margin of double bottom to promenade and to the upper decks, forward and aft of the promenade deck. For one-eighth of the length at each end angle frames are used, these being somewhat easier to work where the bevel is excessive. In the double bottom, which extends from fore-peak to after-peak, the floors are solid plate, united to outside and inside plating by double angles in way of engines and boilers, and single angles elsewhere. Solid intercostals are fitted between the floors. The interior of the double bottom is coated with bituminous and Portland cement. The inner bottom plating has been made unusually heavy, because wooden ceiling is not fitted except under the hatchways. The fore-peak is fitted as a trimming tank.

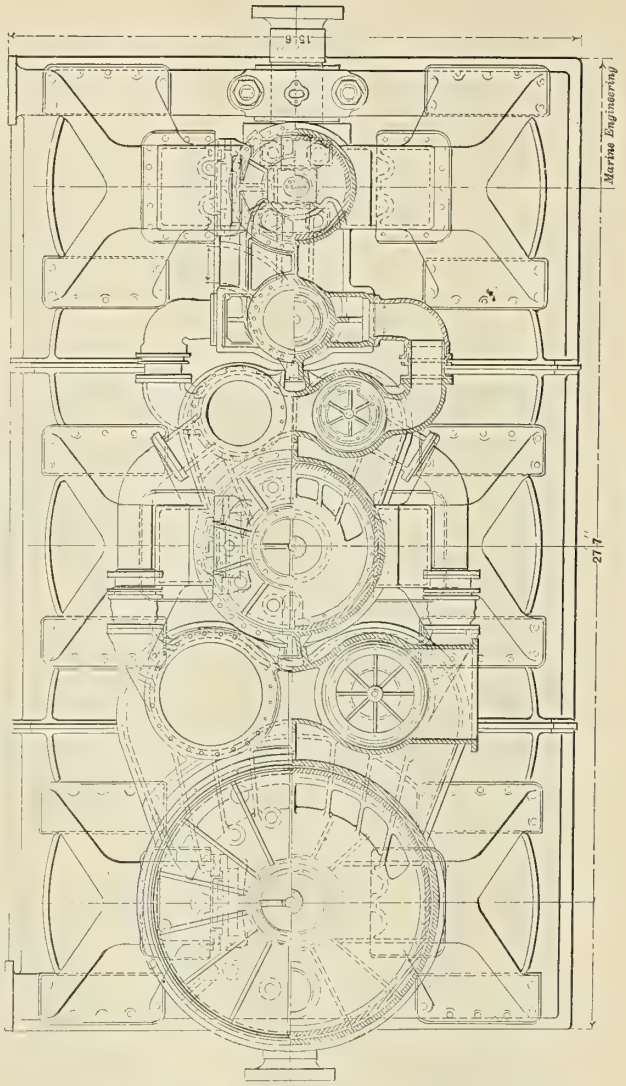
There are eleven water-tight transverse bulkheads



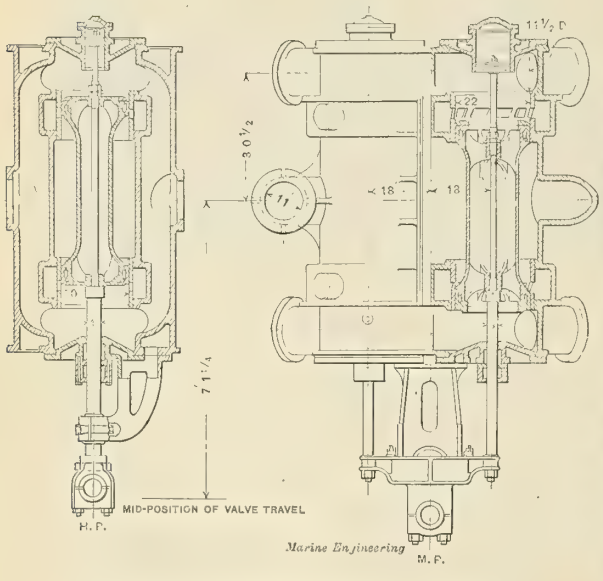
DINING SALOON, FIRST CABIN, STEAMSHIP KROONLAND.

NAME—Krooland. NATIONALITY—American. TYPE—Passenger and Freight Steamship.
LAUNCHED—1902. BUILDER—Wm. Cramp & Sons' S. and E. Company. OWNER—International Navigation Company.

Length over all	560 ft.	Shafting, diam. crank	16¾ in.
" between perps	560 ft.	Tail shafting	18¼ "
Breadth molded	60 "	**Boilers,** number	9
Depth "	42 "	Type	Single-end Scotch.
Draft, load	31 "	Pressure	170 lbs.
Corresponding displacement	22,100 tons.	Diameter	15 ft 10 in.
Block coeff.	.742	Length	10 " 5½ "
Cargo capacity	600,000 cu. ft.	Furnaces in each	4 Fox
Coal bunker	2,000 tons.	Diameter inside	39 in.
Water ballast	2,000 "	Length of grate	5 ft. 6 in.
Engines, number	2	" " tubes	7 " 0 "
Type	Three cylinder, triple.	G. S. total	643.5
Cylinder diameters	32½, 54, 89½ in.	H. S. "	22,400 sq. ft.
Stroke	54 in.	Draft	Cramp's forced.
Valves	All piston.	H. S. ÷ G. S	34.8
I. H. P. on 12-hour trial	10,200	H. S. ÷ I. H. P	2.2
R. P. M. " " "	89.	I. H. P. ÷ G. S	15.8
Condensing surf 2 main	14,000 sq. ft.	Donkey boiler, size, 6 ft. diam by 7 ft. long.	



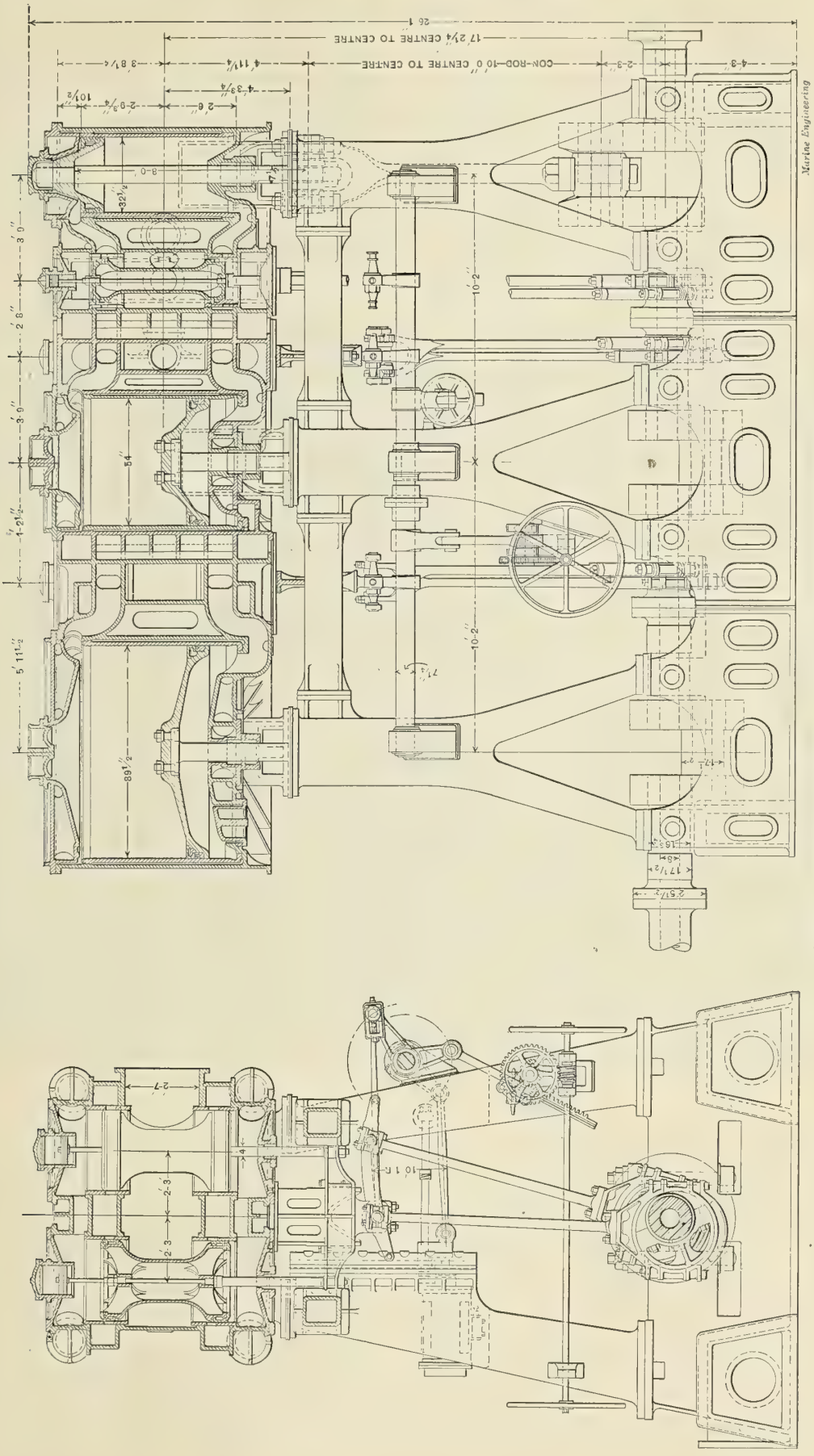
PLAN OF CYLINDERS.



HIGH AND INTERMEDIATE PRESSURE VALVES.

carried to the upper deck, dividing the ship into compartments, any two of which (and in many cases three) might be flooded simultaneously without endangering stability or sinking the ship. These bulkheads fulfill all the recommendations of the Bulkhead Committee appointed by the British Government to report on the best methods of promoting the safety of ships by the use of water-tight bulkheads. The necessary bulkhead doors in the machinery space are of steel plate with brass frames; and they can be operated from the upper deck by gearing, so that in case of any accident the doors may be closed from above.

The stern post and propeller brackets and the lower part of the stern are steel castings; and the rudder is one steel casting, including the blade and the gudgeons for the pintles. The rudder stock is an ingot steel forging coupled to the rudder with six large bolts. The rudder is carried at the upper deck on a white metal bearing of large surface, arranged to be easily removed and overhauled. All the pintles are brass sheathed and fit in lignum vitæ bushes in the gudgeons. Above the upper deck the main and auxiliary tillers are fitted on the rudder head in connection with Brown's patent steam-steering gear. These tillers are of cast steel. In addition to the steam and hand gear, relieving tackles



ONE OF THE THREE-CYLINDER TRIPLE-EXPANSION ENGINES FOR THE STEAMSHIP KROONLAND.

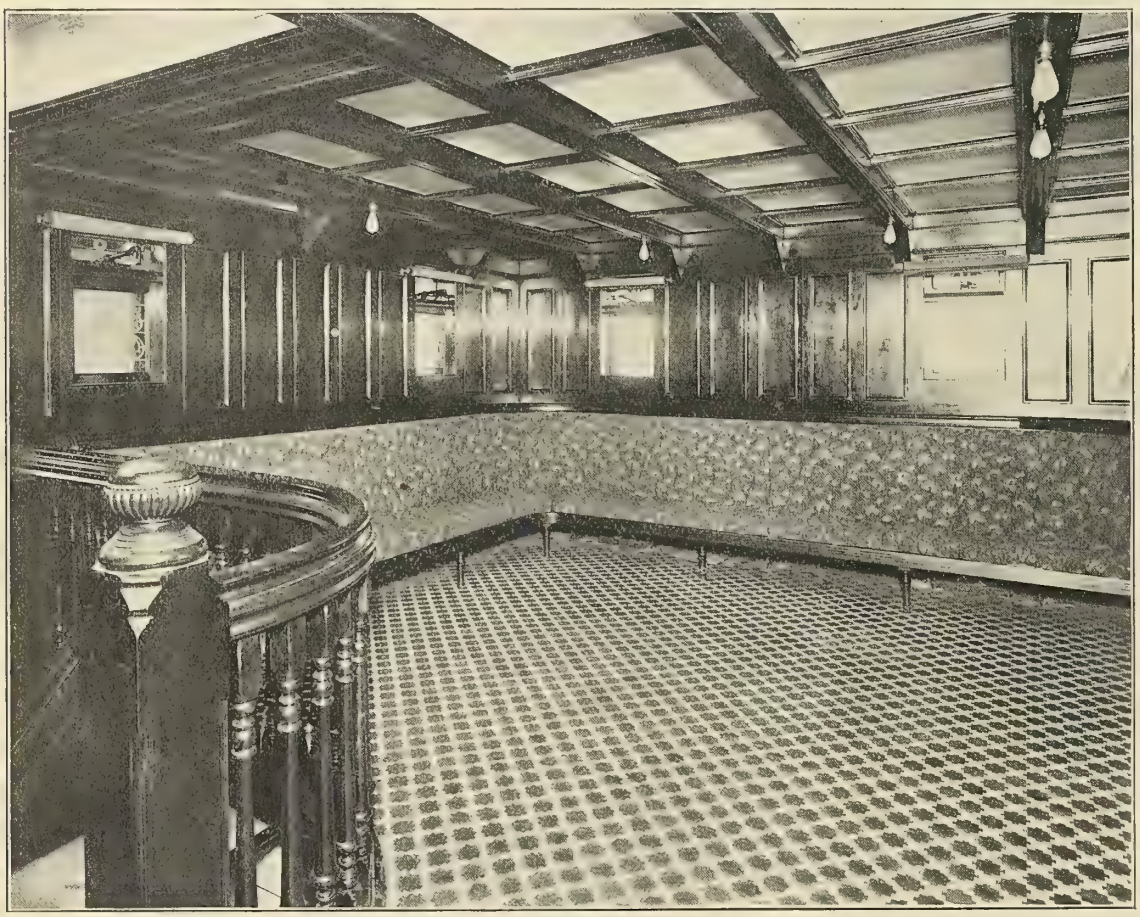
are provided and emergency wire rope gear for use directly on the rudder in event of a fracture of the rudder stock.

The warping gear consists of two large independent steam capstans on the poop, and three large capstans (two independent and one connected to the windlass) in addition to two drums on the windlass on the forecastlehead. These, together with the steering gear, were all supplied by the Hyde Windlass Company. Fourteen helical-geared, double-drum cargo winches are fitted, to be driven by steam at boiler pressure.

Electricity for lighting and power is provided by four 350-ampere generating sets made by the Electro-Dynamic Company. These supply power for the thirteen motors driving the fans for ventilating the passenger and crew spaces and for 1,600 lights throughout the ship. The dynamos are on the orlop deck abaft of the engine room, where they, along with the refrigerating plant, occupy a space the full width of the ship and 15 feet fore and aft. Mechanical ventilation is provided to the dynamo room, and in addition there are two large natural ventilating trunks led from the boat deck, where they are fitted with cowls.

Cochran refrigerating machinery for controlling the temperature of the ship's store rooms is installed. Each room is separately controlled from the refrigerating machinery room, brine pipes being led from manifolds to each room and returned.

The ship is propelled by twin screws driven by two sets of triple-expansion engines balanced on the Cramp principle. The diameters of the cylinders are 32 1-2, 54, and 89 1-2 inches, and the stroke is 54 inches. The steam pressure is 170 pounds. Piston valves are fitted on all cylinders and the valve gear is of the link type. The bed plates and columns are cast iron of ample strength. The crank-shaft bearings are lined with Parsons' white brass, and bushes are round-backed and easily removed when the shaft is in place. The crank shafts, of 16 3-4 inches diameter, are interchangeable, and the line shafts, 15 3-4 inches, are fitted with two of the Verity patent flexible couplings on each line.



ENTRANCE HALL, PROMENADE DECK, STEAMSHIP KROONLAND.

These couplings are intended to prevent strain of the shafting in event of the shaft from any cause becoming out of line. The tail shafts, 18 1-4 inches diameter, are covered with brass 1 inch thick.

There are two separate condensers, one for each engine, made of cast iron, with brass tube plates. The tubes are 3-4 inch diameter, and give a cooling surface in each condenser of 7,000 square feet, or 1.4 square feet per I. H. P. A circulating pump is fitted for each condenser, and the port and starboard pumps are cross-connected, so that either pump may be used for both condensers in event of one pump being stopped. Separate air pumps of the Blake featherweight pattern are provided, one on each side of the ship, and these pumps are also cross-connected.

Steam is supplied by nine single-end Scotch boilers, 15 feet 10 inches in diameter by 10 feet 5 1-2 inches long. The boilers are all placed 'thwartships. In the after boiler room are four boilers fired from one floor. In the forward compartment are five boilers, four of them being placed back to back 'thwartships and the fifth one forward of the center line, thus making two fire rooms, viz: one for the after two boilers and one for the forward three boilers. Coal is supplied through wing and 'thwartship bunkers.

In each boiler there are four Fox furnaces 39 inches inside diameter and 7 feet long, giving a length of grate steel bends and branches; the smaller pipes are copper. Drainage of the steam pipes is thoroughly carried out, and the Holly system of drainage is fitted to the main steam pipes. The main steam pipes are led from the boilers along each side of the ship to the engine room, where they are connected; and valves are arranged so that both engines may be supplied from either one or the other of the pipe lines. The auxiliary steam-pipe system is taken from boilers in each fire room, so that the boilers used in port may be alternated.

The propellers have steel bosses and bronze blades. Steam trials were made on the measured mile in Dela-

LADIES' ROOM AND LIBRARY, STEAMSHIP KROONLAND.

5 feet 6 inches. Separate combustion chambers are fitted to each furnace, and the furnace mouths are flanged inward to enable the furnace to be easily removed. The tubes are 2 3-4 inches diameter by 7 feet long, fitted with retarders. The boilers are equipped with Cramp's system of forced draft, being operated by steam-driven fans, two of which are placed in the after stokehole and three in the forward stokehole.

There are two main and one auxiliary feed pumps, by Worthington, drawing from hot-well and feed heater, with two separate delivery pipes to the boilers with separate checks on the boilers. Evaporators with a capacity of 65 tons per day are fitted.

The main steam pipes, of steel, are used with cast-

ware bay, and afterward at sea before the ship was delivered to the owners.

The *Kroonland* has now made four voyages and has given great satisfaction. Her sister ship, the *Finland,* was launched from the Cramp yard in June of this year and will soon be placed in commission.

Wireless Telegraphy.—Successful experiments in applying wireless telegraphy to submarines have been made at Cherbourg, France. The submarine *Triton* was fitted with a mast and receivers, and, after plunging below the surface, received signals transmitted from the central submarine station with perfect clearness. The system used has been invented by Lieutenant Tavi.

Shipping Commissioners Report.

Reports to the Bureau of Navigation show that during the past fiscal year, Shipping Commissioners at the seaboard shipped 108,554 men on American vessels. Of this number 65,859 were shipped on steam vessels; 42,695 on sail vessels. In the foreign trade 49,060 men were shipped; in the coasting trade 59,494. These figures include the repeated shipments of the same men on different voyages of the same vessels. The number of individual seamen involved did not exceed 20,000. The nationality of the men shipped was: Born Americans, 34,957; naturalized Americans, 14,915; Norwegians, Swedes, and Danes, 16,315; British, 13,897; Germans, 5,640; Italians, 2,297; French, 576; other nationalities, 19,957. These figures also include repeated shipments. Chinese are not shipped on American vessels in American ports, but 521 were shipped at Hong-Kong before United States consul.

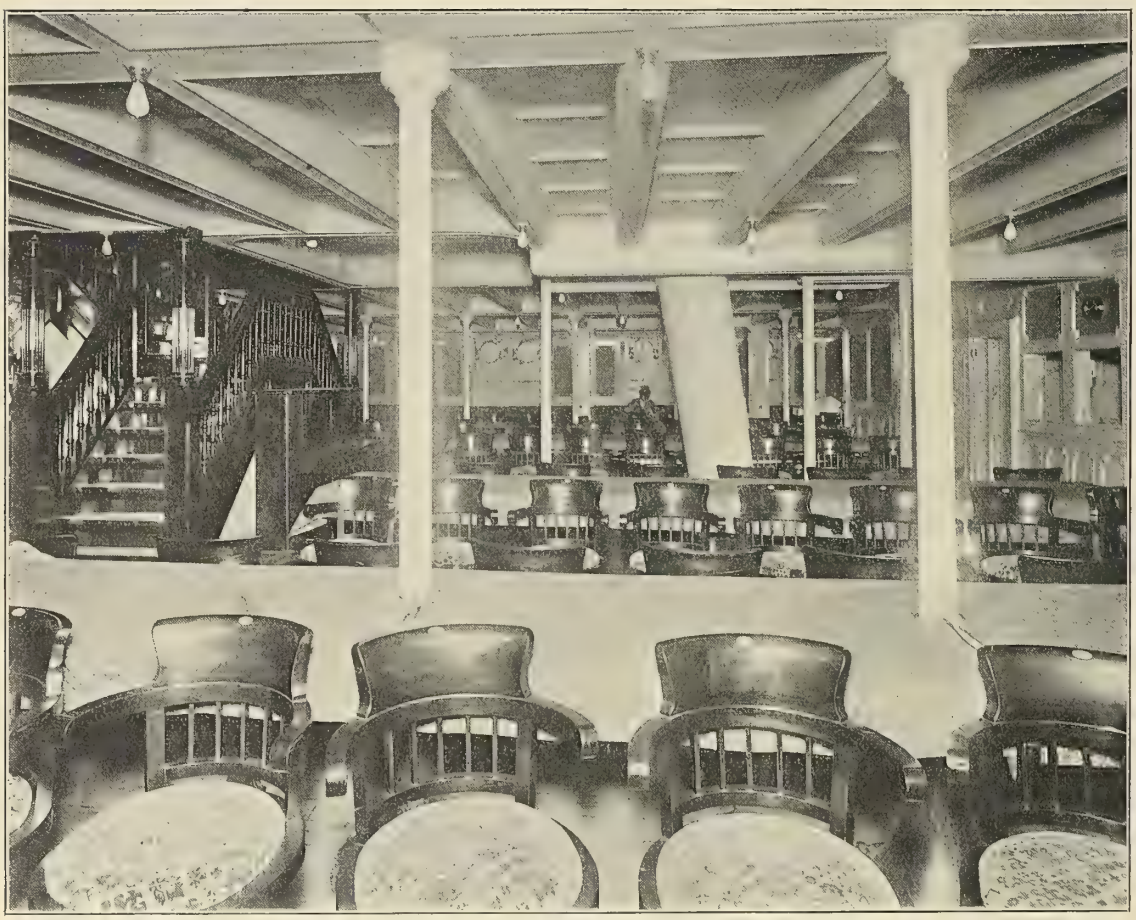
The amount of wages disbursed during the year under Shipping Commissioners' supervision was approximately $2,500,000. The average monthly wages paid to men of all ratings, excluding masters, during the year on American vessels was: Passenger steamers, $36.88; freight steamers, $42.46; square-rigged vessels, $28.94; schooners in the foreign trade, $29.12; schooners in the coasting trade, $33.63; the average wages for all being $35.11, or usually $316 a year. In American ports 3,993 men, or less than 4 per cent., failed to join their vessels.

Electrically-Operated Canals in Belgian Coal Mining Districts.

BY FRANK C. PERKINS.

It would not be surprising if, within a few years, the principal canals in this country, as well as those abroad, were electrically operated, as this method of propulsion is not only very convenient and economical, but also may be made to greatly increase the traffic, on account of the increased speed thus made possible.

The development of electric haulage on canals is slow, but some interesting experiments have been made in this line in Europe; one of the most successful, although working under great disadvantages, is that on the Charleroi Canal in Belgium. This electrically-operated canal serves the Charleroi coal mining region in Belgium with more or less success. The conditions limit the speed and economy, but these could be greatly improved on with an entirely new and modern equipment and a deep and well-constructed waterway.



SECOND-CABIN DINING SALOON, STEAMSHIP KROONLAND.

The experiments on the Erie Canal in New York State, while not in every way successful, demonstrated the fact that electric propulsion is not only possible in this country, but, with plenty of water power at various points on the line, might be made very efficient, as compared with the present methods with horse, mule, or even steam canal-boats. The new power house at Niagara Falls on the American side is nearly com-

pleted, and will add 50,000 horse power more to the present development of the Niagara Falls Power Company, making a hundred thousand horse power for transmission and distribution, with a possible 100,000 horse power more from the same tunnel as a tail race. Another 100,000 horse power is available from the power canal passing through the city of Niagara Falls on the surface, while the Canadian Power Company has already let contracts for a number of 10,000 horse-power turbines and generators, and when completed this plant will add 200,000 horse power more. It will thus be seen that practically half a million horse power is already in sight for electrical power transmission in and about Niagara Falls, Western New York, and Canada. It will, therefore, be surprising if the Erie Canal, as well as the Welland Canal in Canada, are not looked to in the near future as users of this power; and electrical canal haulage will without doubt increase the traffic of ore and coal from the mining regions about the Great Lakes.

The coal mining regions of Belgium, in the Charleroi district, are connected with Brussels and Antwerp by the Charleroi electric canal, which is a narrow waterway about 50 miles long. There are two central power stations, one at Oisquercq, 15 miles south of Brussels, and another at Roux, 6 miles north of Charleroi. These stations are 29 miles apart, and the former is equipped with three 125 horse-power Corliss engines, each driving a polyphase alternator constructed by Brown, Boveri and Company, of Baden, Switzerland. These machines supply an alternating current of 15 amperes each, at a potential of 6,000 volts.

The power station at Roux is of larger capacity, the engines and generator sets having a capacity of 325 horse power each, as they supply current for lighting and industrial purposes, as well as for operating the canal apparatus at various points along the line.

There are sub-stations located at points along the canal about three miles apart. Each of these contains a step-down transformer, which lowers the pressure from that on the transmission line, or 6,000 volts, to that used on the trolley line, or 600 volts.

This electrical haulage system was designed and constructed under the direction of Leon Gerand, the consulting engineer of the Compagnie Générale de Traction Electrique sur les Voies Navigables, to whom the writer is indebted for the information regarding this electrically-operated canal.

CHARLEROI ELECTRICALLY-OPERATED CANAL.

The "tracteurs," or electric automobiles, one of which is seen in detail on page 446, are used to draw canal-boats in the same manner as horses or mules, and each has a capacity of about five horse power. They work over sections of various lengths, and when they meet another going in the opposite direction they do not pass each other, but exchange tow lines and return with the boat they meet; the outfit not being turned around, but the operator simply changing his seat and facing in the opposite direction, the controller still being within easy reach, as seen in the accompanying drawing.

The banks of the canal are so narrow and in such poor condition for much of the way that electrically-operated tugboats are also employed, as shown above, which have a speed of 8 miles per hour. An

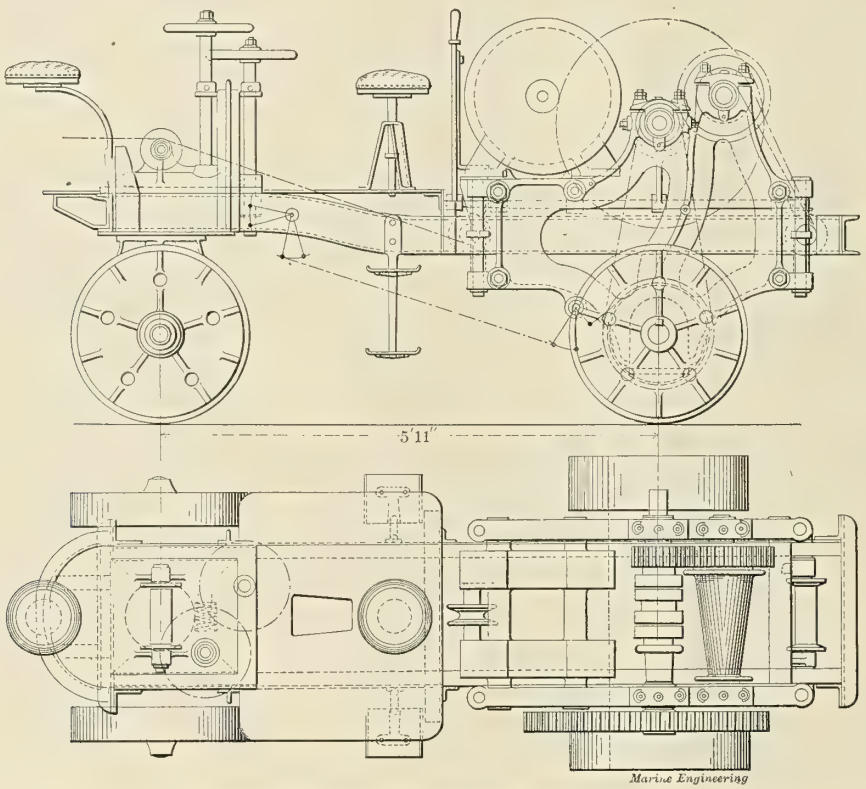
insulated cable conveys the current to the boat from a three-phase trolley line, in the manner indicated in the illustration, this cable being supported from a pole attached to a mast on the boat, and trolley device of the peculiar construction shown, which seems to operate at speeds of 6 and 8 miles per hour without trouble, although a speed of only 2 miles per hour is used in towing two 70-ton boats. The mast is about 14 feet above the water, and the boat can travel at a distance of 50 feet or more from the line and is free to turn around and manœuvre similarly to a steam tugboat. The boats have a capacity of 70 tons, with a draft of only three feet, and are greatly hampered by the depth of water, which is only about 3 1-2 feet. On account of the narrow path, and heavy and irregular loads due to this small depth of water, with considerable mud on the bottom, the speed is low and the amount of energy required is comparatively large, the necessary current being about 6.5 kilowatt hours per boat mile, although this has been lowered to 5.5 per boat mile, while the mean traction pull is 350 pounds, and the maximum 1,320 pounds.

It was of considerable importance to more efficiently connect Brussels with the Charleroi coal district, and the electrical haulage has done this satisfactorily, considering the conditions of the canal, increasing the speed of towing from 1 1-4 miles per hour, which was the rate of speed with horses, to 2 1-2 or 3 miles per hour with the electric system, and with no additional cost per mile for an equal tonnage, which averages about 25 cents per boat per mile. The total traffic per year amounts to more than half a million tons.

The motor car, or tracteur, is equipped with a winch, which may be electrically operated from the motor axle, which the operator can disconnect from the wheels; and by this electrically-operated winch a stranded boat may be relieved, and a boat may be forced out of a lock. With the electrical method of haulage the passage of a lock may be made in less than five minutes, while it took three times as long for the passage of a lock previously with horses on the Charleroi Canal.

The Mons district is connected to the sea only through French territory, but the Liege district is connected by both river and canal over a trifle more than 100 miles, and Brussels is about 30 miles from Antwerp along the canal.

Considerable has also been done with electric propulsion of canal-boats both in Germany and in France, on the Finow, Aire, and Deule canals, the latter between Bethune and Douai.



ELECTRIC AUTOMOBILE FOR BELGIUM CANAL SERVICE.

Lloyd's Shipbuilding Returns.—From the returns compiled by Lloyd's Registry of Shipping it appears that, excepting warships, there were 406 vessels of 1,129,582 gross tons under construction in the United Kingdom at the close of the quarter ending June 30, 1902. This is a decrease of thirty-five vessels of 170,571 gross tons from the high-water figures of the corresponding quarter of last year. The falling off is chiefly in the districts of Greenock, Hartlepool, and Whitby, although all districts, except one, namely, Barrow, Maryport, and Workington, show a decrease, and this one shows an increase of from about 12,000 to 26,000 gross tons. The Glasgow district is about the same, and the Belfast district is but slightly less than last year.

REPORT OF RECENT OIL BURNING INSTALLATIONS ON THE PACIFIC COAST.

BY EDWARD S. HOUGH AND WM. H. CRAWFORD, JR.

In order to keep pace with the progress made in the use of oil for fuel, it is necessary to have reports from various parts of the world where this modern practice is being developed. The subject is by no means a new one, although new phases of it are continually presenting themselves to those engaged in the investigations.

It is not necessary to enumerate the advantages derived by making a change from the use of coal to that of oil for fuel. These are about the same everywhere, although in this part of the world particular emphasis can be laid on the item of economy in the first cost of the liquid as compared with the price of coal delivered here. California is fortunate in having its own oil wells and in being at no great distance from the largest oil fields in the United States, whereas coal must be imported, and in the past has come from British Columbia, Puget Sound, England, Australia, and Japan. There is probably no field where liquid fuel will find greater support than on the Pacific coast of the United States.

The following illustrations will give a fair idea of the experience gained in marine work at the port of San Francisco. They must necessarily be given in detail to enable those interested in the subject to figure out their own conclusions, should it appear that the deductions are not properly made. Three steamers will be considered, each under a separate heading. They are all small craft, but represent different types of installation. After these examples we will look into the case of an ocean-going steamer running between this port and the Hawaiian Islands, the first engaged on a long ocean run.

VESSEL NO. I.

This example is a steam schooner built of wood for the lumber trade on this coast; she is intended particularly for the red-wood trade, taking her load in northern Californian ports and delivering in San Francisco and points in southern California. This vessel has, however, gone as far north as the Columbia river. She is 137 feet long, 34 feet beam, and 12 feet deep. Two fuel-oil tanks are fitted in the main hold immediately forward of the water-tight bulkhead, located forward of the main boilers, and two tanks forward, also under the main deck, between collision bulkhead and foremast. The total capacity of the four tanks is 15,000 gallons. The ceiling of the vessel under the tanks is lined with galvanized iron in the form of a trough, in order to catch any seepage which might occur from the oil tanks.

The oil system used is that of atomizing by compressed air. The tanks are double riveted throughout and are thoroughly well braced and partitioned internally, so that they will stand a pressure of 15 pounds per square inch without bulging the flat surfaces. All pipe connections are taken from the top, and only pressed-steel flanges are used, and these are riveted to the tanks and calked. There is an air-vent pipe taken from each tank to the atmosphere. The valves are so arranged that the oil pump can draw from any one tank, irrespective of the other three. The after tanks are filled through a 6-inch pipe, and the forward ones are filled through the manholes.

There are two main boilers, 8 feet 4 inches diameter by 10 feet long, of the Scotch marine type. The boilers were originally designed to burn coal and each contains 810 square feet of heating surface. There is one furnace, 46 inches in diameter, in each boiler. The tubes are 3 inches by 7 feet and are fitted with retarders. The whole of the furnace is effective as heating surface.

The engine is a two-cylinder compound, working on two cranks, with cylinders 14 and 32 inches in diameter and a stroke of 24 inches, working under 150 pounds steam. This engine can indicate 400 H. P. There are the following auxiliaries in constant running: an air compressor having two steam cylinders 6 by 6 inches and making 45 revolutions per minute; one centrifugal circulating pump engine, steam cylinder 4 by 5 inches; one large and one small duplex oil pump, and at night one electric generator engine, cylinder 5 by 5 inches. The large pump is used to draw oil from the fuel-oil tanks, thus leaving the smaller one to supply oil to the burners, acting as a force pump only.

The tank pump is a duplex Worthington, 4 1-2 by 2 3-4 by 4 inches, with a return pipe to suction. This pump draws oil from the tank and delivers to the intermediate receiver situated above the boilers. There is an intermediate oil receiver above the boilers between the tank pump and the oil tank. The force pump is a duplex Worthington, 3 by 2 by 3 inches, which takes oil by gravity from the intermediate receiver and delivers to the heater reservoir. The oil heater reservoir is detailed in the accompanying drawing and consists of a cast-iron shell with an internal heating coil of copper. This coil is made strong enough to allow of live steam being used for heating the oil.

There is a float with rod connected to a lever through a stuffing box. The lever is connected to the throttle valve of the force pump by a link, thus controlling the speed of the force pump and consequently the level of the oil in the reservoir. The reservoir is usually kept about one-half full of oil, the top half acting as an air vessel. There is a tandem duplex steam-driven double-acting air compressor, cylinders 10 1-2 inches air, 6 inches steam, by 6 inches stroke, with an air receiver 24 by 72 inches. The burners, which deliver a circular flame, are of local manufacture, two being fitted to each furnace.

The compressor delivers air at 15 pounds pressure to the top of the heater reservoir, and the force pump delivers oil near the bottom, and the balance is established, resulting in the burners being supplied with oil and air at equal pressure. The temperature of the heater reservoir will vary from 150 to 180 degrees Fahrenheit, the latter when using an oil under 20 degrees gravity. The temperature of the incoming air at the compressor is 100 to 120 degrees, and the volumetric efficiency of the compressor is 80 per cent. The actual quantity of free air delivered per minute is 43.28 cubic feet to the four burners.

It will be seen that in this case the piston speed of the compressor is low, therefore smaller cylinders

could be used, the piston speed being increased accordingly.

Temperature of oil at heater	150 to 180 deg.
H. P. to supply air for atomizing	3
Total power furnished by boilers	300
Power of compressor compared with main engine	1 per cent.
Water evaporated per min., calculated from indicator cards	102.5 lbs.

The compressor engines exhaust through the coil in the heater reservoir to the main condenser. Allowing 50 pounds water per I. H. P. per hour for these engines and the circulating engines, and 20 pounds for the main engines, we then have about 2 per cent. of the gross feed water required to supply air for atomizing. It is evident that by compounding the steam cylinders of the air compressor this can be reduced.

Consumption of fuel oil per hour	59 gals., or 472 lbs.
Fuel oil per I.H.P. hour	1.57
Water evaporated per pound of fuel per hour	13

VESSEL NO. 2.

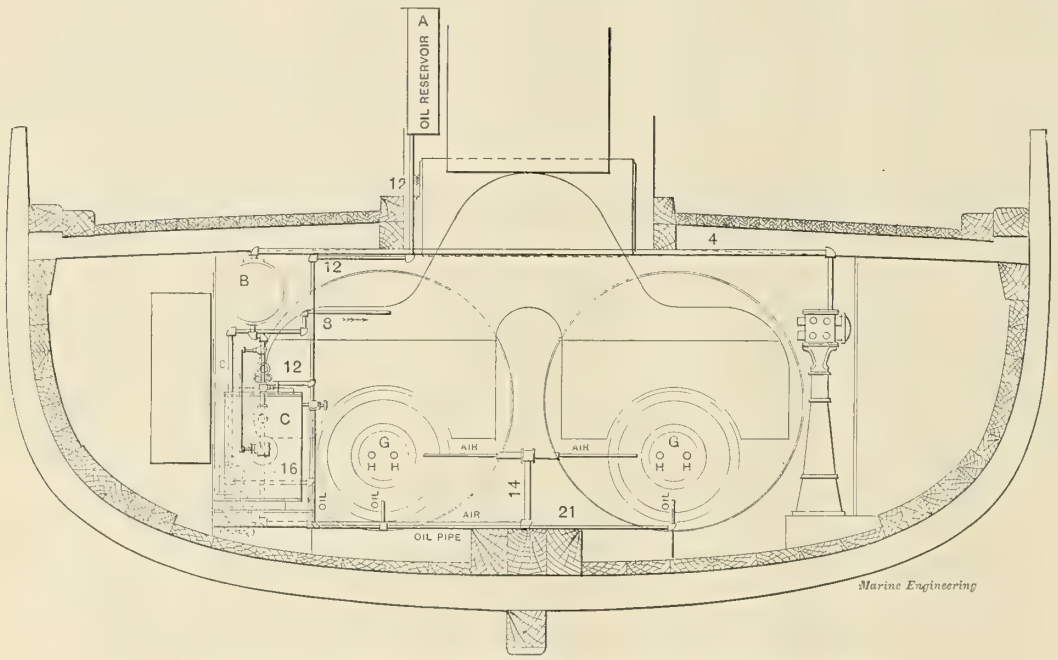
This vessel is also a steam schooner built of wood for the lumber trade on this coast, and is 160 feet long, 33 feet beam, and 15 feet deep. She carries two fuel-oil tanks, one on each side in the two fore and aft bunker spaces, with a total capacity of 17,000 gallons. The ceiling of the vessel under the tanks is lined with sheet lead to form a trough, as in the previous example.

The oil system used is the same as in No. 1, viz., atomizing by compressed air. The tanks are also of the same detail construction, the shape, however, being such as to conform to the bunkers. All pipe connections are taken from the top of tanks. The bunker plates next to the boiler are covered with magnesia non-conducting material 1 inch thick.

There are air inlet pipes to the bunker spaces about the tanks, and a suction pipe from the air compressor is carried to the bunker spaces. All the air required for the compressor is, therefore, taken through the bunkers, carrying with it any gases emanating from the oil, should leakage occur from the tanks. It also keeps down the temperature of the bunkers, which rises when the vessel has a deck load. In other respects the oil plant is a duplicate of example No. 1.

There is one two-furnace boiler 11 feet by 10 feet 6 inches, of the Scotch type, which contains 1,200 square feet of heating surface and was designed to burn coal.

The engine is a two-cylinder compound, working two cranks, with cylinders 14 and 32 inches diameter

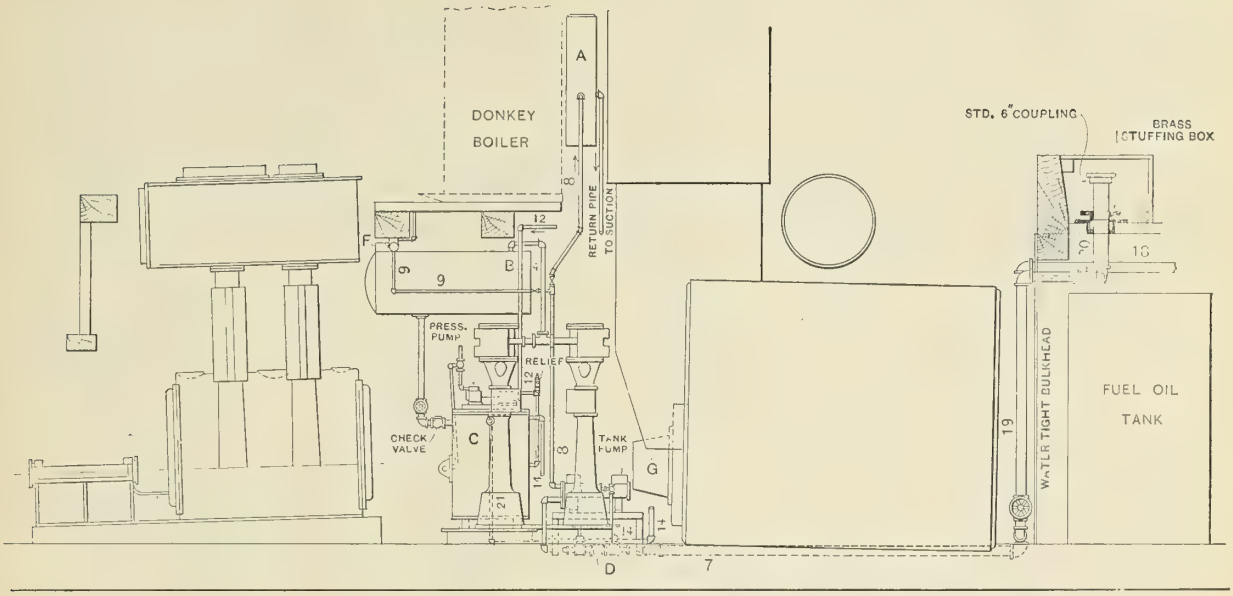


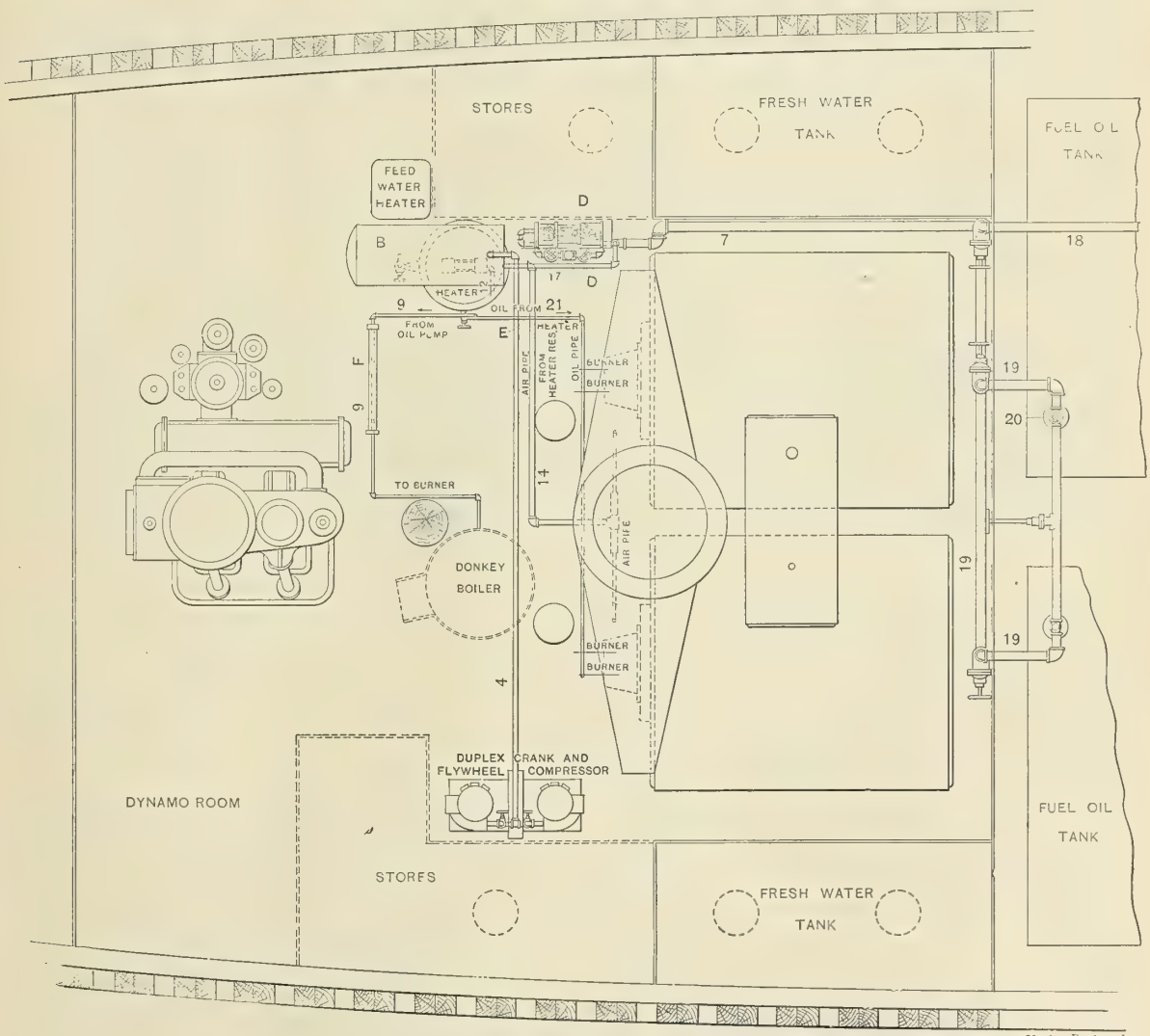
MIDSHIP SECTION OF STEAMER, SHOWING ARRANGEMENT OF FUEL-OIL PIPING.

SIZES OF PIPES IN DRAWINGS, PAGES 448-9.

1. 1 1-2 inches auxiliary steam.
2. 2 inches to heater.
4. 2 inches to air receiver.
5. Auxiliary steam.
7. 4 inches from main oil suction, 2 inches at pump.
8. 1 1-2 inches to oil reservoir.
9. 3-4 inch to heater for auxiliary B.
10. Auxiliary steam.
12. 1 1-2 inches from oil reservoir reduced to 1 1-4 inches at pump.
13. 1 inch to heater.
14. 2 inches air from heater reduced 1-2 inch at burner.
16. 1 1-2 inches return from oil reservoir to suction.
17. 2 inches air for tank below.
18. 4 inches from forward oil tank to main suction.
19. 2 1-2 inches from main oil tank to main suction.
20. 6 inches oil-filling pipe.
21. 1 inch oil from heater reduced to 3-4 inch at burner.

A. Oil reservoir.
B. Air receiver.
C. Oil heater.
D. 2-inch strainer.
E. Compressor.
F. Oil heater for donkey boiler.
GG. Extension fronts lined with fire clay.
HH. Holes for burners.





Marine Engineering

PLAN AND ELEVATION OF STEAMER, SHOWING FUEL-OIL PIPING.

by a stroke of 24 inches. Under 160 pounds of steam this engine indicates 400 H. P.

The auxiliaries are the same as in example No. 1. The above is given as an illustration of method of stowing tanks near boiler. Oil varies from 16 to 21 gravity.

VESSEL NO. 3.

This example is a modern stern-wheel steamer designed for bay and river service. Length 130 feet, beam 30 feet, and depth 7 feet 6 inches. There is but one fuel-oil tank, forward, and the ceiling under the oil tank is lined with lead.

This oil system consists in vaporizing the oil with the steam by passing the mixture through a furnace.

There are two plain tubular boilers, 60 inches in diameter and 18 feet long, each having forty-four 4-inch tubes. The boilers are designed for burning coal and for a steam pressure of 170 pounds. The engines are double tandem compounds, the two high-pressure cylinders being 12 1-2 inches diameter, the two low-pressure cylinders 26 inches, and all have a common stroke of 72 inches. These engines, including auxiliaries, develop on regular run 275 H. P.

The auxiliaries include one independent compound air and circulating pump, 6 by 12 by 10 inches; one compound feed pump, 6 by 12 by 6 inches; one electric light engine; one oil pump, 4 1-2 by 2 3-4 by 4 inches; two duplex Worthington pumps, 6 by 4 by 6 inches, working alternately, and one vertical heater and air vessel between pumps and burners.

There is one circular burner under each boiler, delivering through a pipe with flattened end, thus throwing a broad flame. The incoming air for combustion, taken through the burners, is passed through a pipe secured in the uptakes. The temperature of the air is thus raised to 330 degrees before entering the furnace.

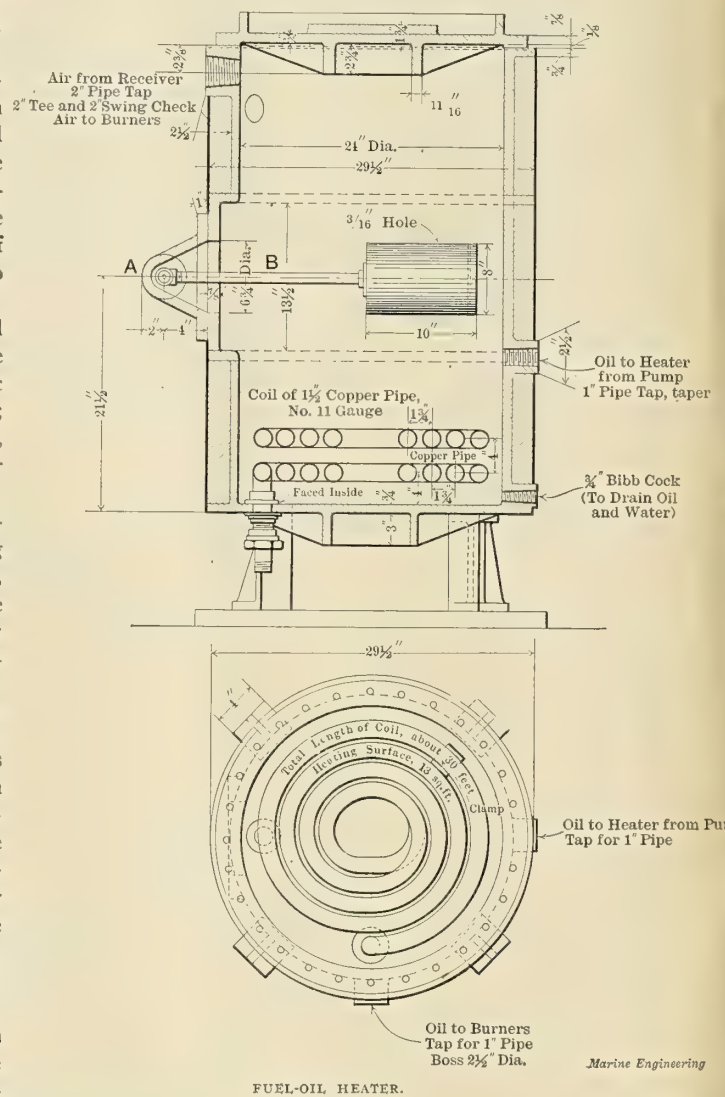
Consumption of oil per hour..... 73 gals.
Weight of oil consumed per hour.....584 lbs.

Unfortunately, reliable information on the subject is hard to get, inasmuch as the great saving made in adopting the oil-burning system has for a time satisfied shipowners, so that the further economy of one system of atomization over the other has been a neglected point. The economy of oil fuel, however, over that of coal is assured. Whether it is better to use compressed air for atomizing the oil, or to use steam and fit a ship out with adequate evaporators, is still an open question.

In the examples just considered we are able to begin an argument. As a check on some of the data we can look to a recent test on the Southern Pacific Railroad, where it was desired to determine the amount of steam required to atomize the oil used in evaporating a given quantity of water. There were two series of tests, and it was shown that 3.4 per cent. in one case and 3.8 per cent. in another of the gross feed water was consumed at the burner.

Regarding our example of an ocean-going oil burner we have some interesting information from Chief Engineer Coryond Lamond.

This steamer is provided with two single-end, three-furnace boilers, and a donkey boiler. Her engines develop about 900 H. P., the cylinders being 25, 38, and 72 inches, with a 48-inch stroke. She is a freight boat with limited passenger accommodations, hence the electric-light plant is comparatively small, which, with its auxiliaries, does not add much to the work of the boilers. There is also a refrigerating apparatus. This ship was fitted out with a compressed-air system, but the Chief informs us that 24 hours after leaving port on her first trip the compressor broke down, and he was compelled to resort to the use of steam, which was continued on the succeeding trip. The amount of air required was far in excess of the calculated needs, and hence it was necessary to drive the compressor until it



FUEL-OIL HEATER.

gave out. The burner used here may have been responsible for the miscalculation. It seems well adapted to the use of steam, however, and is of local make, delivering a circular flame.

On this ship is an evaporator with an average capacity of 2,700 gallons of water per day, which is able to supply more than enough fresh water when clean and in good condition. The total fuel-carrying capacity is 2,400 barrels of oil, which is enough to last for the round trip from here to the Hawaiian Islands. The oil is carried in the ballast tanks in the double bottom of the ship, and from there it is pumped into two large

settling tanks, and from the settling tanks to the heater.

Originally, when air was used for atomizing, before the failure of the compressor, the fuel oil was carried one-half full in the heater and the space above charged with air at 25-pounds pressure. When it became necessary to change over to steam atomizing, the oil was allowed to carry full in the heater, and steam was admitted only at the burner at about 35 to 40 pounds per square inch.

The total fuel consumption amounts to about 100 barrels of oil per day. The steam pressure carried is 150 pounds. As a coal burner, this ship averaged 20 tons per day and logged 9 1-2 knots. Now she makes 10 1-2 knots with the above consumption of oil. As to the total economy in the use of oil fuel on this ship over cost of burning coal, the Chief figures that it will be between 30 and 40 per cent. In the fire room he has a saving of $270 per month in wages alone.

The *Mariposa* will be the next steamer of any importance to leave here with oil-burning apparatus. Her run is to Tahiti and return, about six weeks. The oil tanks in this ship are built in a part of the forward hold. Compressed-air atomizing will be used.

New Battleships.—The battleships recently authorized by Congress are to be 450 feet long on load-water line, 76 feet 10 inches extreme beam, 16,000 tons displacement, 18 knots speed.

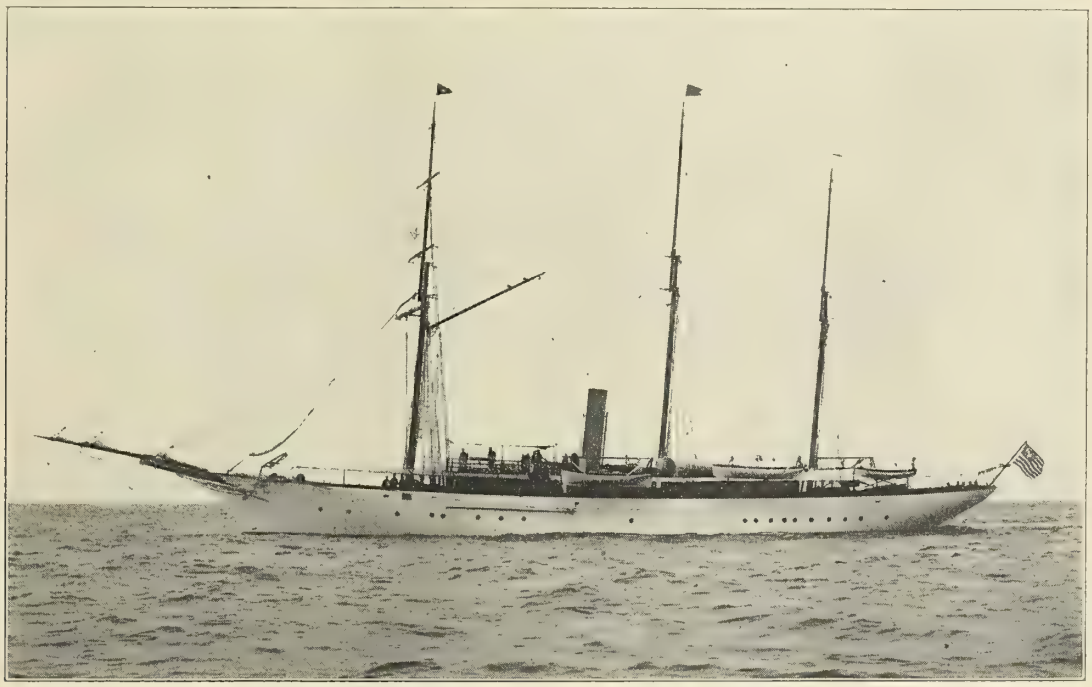
Lengthening Ships.—The new Clyde Line steamers *Apache* and *Arapahoe* are soon to be docked and lengthened 60 feet by the Messrs. Cramps. Several of the other vessels of this line have already been lengthened, and it is stated that two additional boilers will be fitted in the *Apache* and *Arapahoe*.

Roller Bearings for Marine Engines.

BY STEPHEN P. M. TASKER.

While roller or ball bearings have been used largely on small machinery and launches, their use on large marine work has been limited to a great degree. It is in just such construction that their general use will be more and more appreciated, as their advantages are better known and understood, and their defects overcome.

There is a line drawn between ball and roller bearings. The advantages of the latter have so far shown themselves that we will consider them only; besides, in most parts, it is impossible to use a ball, for the difficulty and cost of getting them true and exactly of the same size, the difference of material and hardness, their liability to crack, the grooves they are apt to wear under great pressure and the small area they cover in comparison with the roller have placed this type far behind, when we wish a practical bearing with the least wear and friction. Generally, at both ends of a bearing are the only places where balls can be used, while the roller can extend from end to end, giving all that extra bearing surface. The advantages of a ball are all covered by a roller, and except for small light work where the minimum of friction is required, the ball is at a disadvantage, although we must admit that it gives less friction. This is nothing compared to the jump from white metal or brass to roller.



STEAM YACHT SAGAMORE, FITTED WITH ROLLER THRUST BEARING.

After the results of the test to be undertaken by the British Admiralty, to determine the actual power used in running the engines and in overcoming the friction, the advantages of giving some of this power to the propeller, instead of using it up in overcoming the great friction that our modern marine engines have, will be better appreciated.

Could not rollers be easily applied to the crossheads, main bearings, crank-pins and slides? It would be easier

to insert a new roller, or new set for that matter, than to re-babbitt or take down and scrape a brass bearing. To keep a crosshead cool, and the high pressure especially, is one of the hardest nuts an engineer has to crack. With higher steam pressures the temperature rises, the load and the size of rods increase, and before we start the engine we have a hot crosshead. A bearing that heat does not affect is badly needed for both ends of the connecting rod. Rollers carefully made and tempered ought to improve this, and spare ones could be so easily applied; this applies to the slipper-face, steady bearings, etc.

Installing rollers in the crank-pins, main-bearing and crosshead, while in nature of an experiment, would be worth the trial, for there are many points in engineering gained solely by experiment.

The principal and best use to which a good roller can be put is in a thrust bearing. This was thoroughly tested in the steam yacht *Sagamore*, property of Edward C. Lee, of Philadelphia.

The *Sagamore*, being a thoroughly modern ocean-going yacht of 700 horse power, was chosen to test and compare this type of bearing. That we may be able to note the results gained solely by the addition of roller thrust, her main dimensions and particulars are added, being interesting in themselves.

The auxiliaries consist of a Sturtevant blower, feed heater, ash hopper, 300-pound ice plant with 500 sq. ft. of cooling surface for chests, evaporator, 50 gallon distiller, steering engine, one 80 volt 90 amp. electric light plant, storage batteries, donkey pump, brine pump, independent feed, two direct connected feeds, one direct connected bilge pump, one circulating pump, windlass engine and pumps for galley and water tanks.

The old horseshoe thrust gave the trouble that every engineer had to put up with, requiring a special water service pump for this only, and the quantity of oil used was considerable, besides the waste and dirt connected with it. On installing the new bearing, the pump's services were dispensed with, the oil was cut off almost entirely, the frequent adjusting needed for the old bearing was saved, and at highest turns and slowest speed there was no heating whatever, but the gain in revolutions and speed was marked with exactly the same conditions as with the old bearing. The engines turned eight revolutions more per minute and over a measured course made .7 of a knot better speed. This is a gain of 7 per cent. in revolutions, solely by a new thrust bearing of the roller type. These results should attract the attention of every yacht and steamship owner. The saving in cost of operation, the increased revolutions, and gain in speed, would more than pay for the little trouble of installation. The old body of the thrust and thrust-shaft could be used, and simply new roller horseshoes added.

It is found that true, cylindrical rollers act as well, if not better, than the tapered ones, besides having no tendency to work from the center. They require no change to the shaft collar or thrust-bearing body.

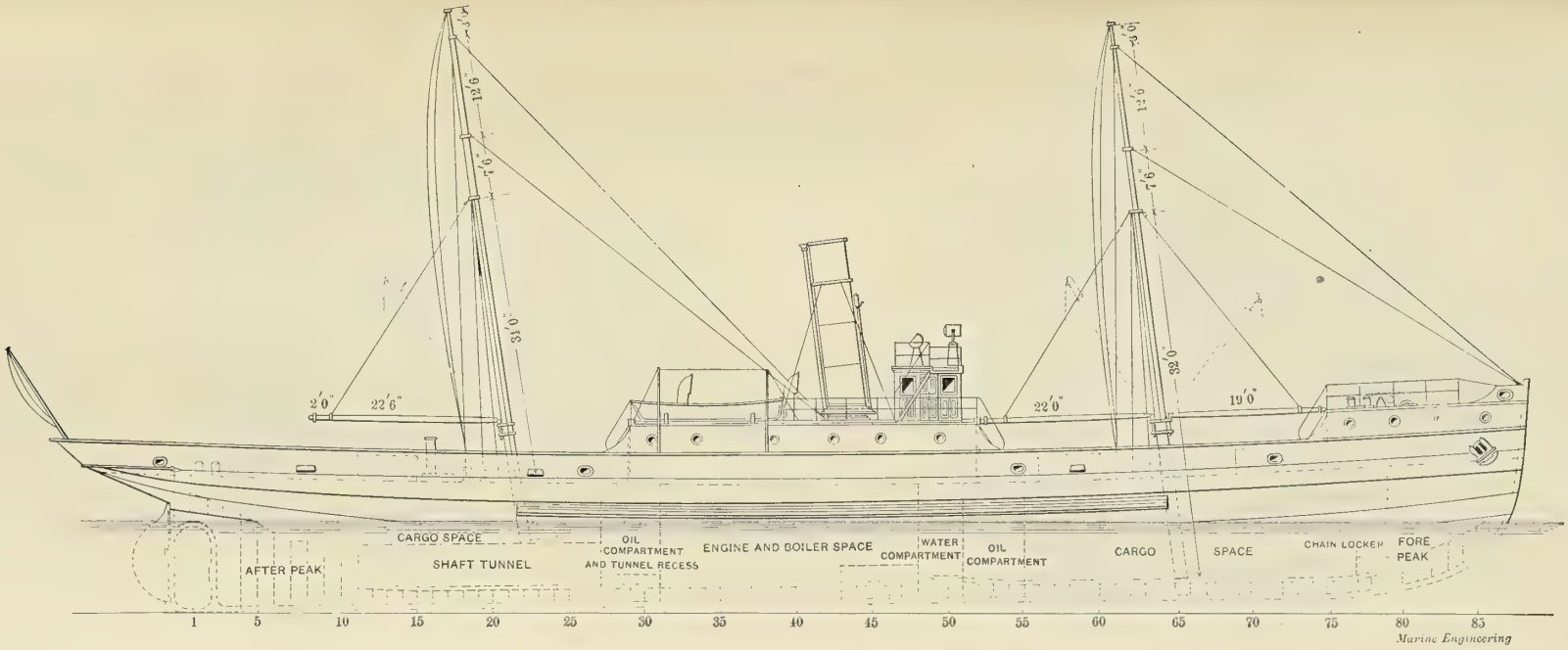
The advantages of a roller thrust have proved themselves, and if we will adapt them to the line shaft bearings and to as many other places as opportunity will allow, greater results than these will follow. An increase of from 7 to 10 per cent. in revolutions ought easily to be accomplished with a proper roller thrust, and more than this, if we will add the steady bearings, which simply take the weight of the shaft, and in doing so, use up the friction.

Before installing the new thrust under the same conditions as those of the accompanying table, the engine made 122 revolutions and 13.3 knots.

NAME—SAGAMORE — NATIONALITY—AMERICAN — TYPE—STEAM YACHT
LAUNCHED—1888 BUILDER—NEW ENGLAND SHIPBUILDING CO. OWNER—EDWARD C. LEE

Length over all	184 ft.	Admiralty coeff.	305
Length L. W. L.	160 ft.	**Boilers**, number	2 single-end Scotch
Beam	26 ft.	Pressure	160 lbs.
Draft	12 ft.	Diameter	9 ft. 6 in.
Corresponding displacement	685 tons	Length	10 ft.
Area, midship section	225 sq. ft.	G. S.	70 sq. ft.
Midship section coeff	.72	H. S.	1,700 sq. ft.
Block coeff	.48	Furnaces in each boiler	2
Wetted surface	5,000 sq. ft.	Diameter of furnaces	39 in.
Coal capacity	100 tons	H. S. ÷ G. S.	24.3
Engines, number of	1	H. S. ÷ I. H. P.	2.4
Type	3 cylinder, triple expansion	I. H. P ÷ G. S.	10.0
Cylinders, diameter	15, 24, 37½ in.	W. S. ÷ I. H. P.	.7
Stroke	30 in.	Length of Boiler Room	30 ft.
I. H. P.	700	**Propeller**, 4 blades, composition	
Reduced M. E. P.	32 lbs.	Diameter	8 ft. 6 in.
R. P. M.	130	Pitch	12 ft. 10½ in.
Condens. Surf.	912 sq. ft.	Developed area	24 sq. ft.
Speed	14 knots	Slip	15%
Length of engine room	16 ft.	Total weight of machinery and auxiliaries	91 tons

Admiralty Boiler Committee.—The committee appointed by the Lords' Commission of the British Admiralty to consider certain questions respecting modern types of boilers for naval purposes has at last issued its report. Therein are enumerated many disadvantages of the Bellville boiler as compared with the cylindrical boiler, and, in the judgment of the committee, the advantages possessed by this type are more than counterbalanced by the disadvantages. In the Interim report the committee advises the use of the Babcock and Wilcox, Niclausse, Durr and Yarrow water-tube types, all of which, the committee states, are free from the disadvantages of the Bellville. The Babcock and Wilcox boilers of the *Martello* are cited as having stood the test of usage very well. Besides recommending that the above boilers be used in H. M. Navy, the committee advises that the development for marine purposes of the following mentioned boilers should be carefully watched, namely, Weir, Sterling, Thornycroft-Marshall, and Thornycroft-Shultz.



FISHING STEAMER BUILT AT CRESCENT SHIPYARD.

Fishing Steamer.

A unique fishing steamer for service in Southern waters, built to the order of the Gulf Fisheries Company, is under contract at the works of the Crescent Shipyard, Elizabethport, N. J. The vessel is to be used in gathering the catch from the fishing fleet and bringing it in to the Southern markets, and on the return trip the vessel will take out stores, bait, mail, etc., to the fleet. To accomplish this work she has been designed as a very speedy craft, and is expected to make 14 knots.

The general dimensions are:

Length over all	176 ft. 3 in.
Length perpendiculars	160 ft. 0 in.
Beam, molded	24 ft. 0 in.
Depth, molded	14 ft. 0 in.
Draft	10 ft. 0 in.
Displacement	500 tons.

She is a single deck vessel with forecastle and bridge and is divided into 8 water tight compartments by transverse bulkheads. A large chain locker is in the after peak, and aft of this is the forward hold, 40 feet long, and with a capacity of 8,000 cubic feet. Aft of this is a transverse oil tank 7 feet long, extending the breadth of the ship. Next comes the deep well 5 feet 6 inches long, in a fore-and-aft direction. The boiler and engine room are in one compartment 30 feet 6 inches long. Aft of this is the second oil tank extending the breadth of the vessel and 7 feet long. The after hold runs from this tank 36 feet 6 inches to the after bulkhead, and contains 4,050 cubic feet. The forward and after holds will be used for carrying the cargo of fish either in bulk or in crates.

One of the novel features of this vessel will be the equipment of boilers with oil burners, 70 tons of fuel oil being carried in the two oil tanks above mentioned. The water tank will carry 30 tons of water.

The crew's quarters are in the forecastle, and the officers and engineers have separate and commodious cabins in the bridge house.

The ship is built with a bar keel, and is of steel throughout, except part of the deck plating over the holds. She will have two masts with two derricks on the foremast and one on the main, and at each mast will be located a cargo winch. There is a windlass in the forecastle which operates the capstan on the deck above.

There will be water tube boilers of 80 square feet of grate surface furnishing steam at 250 pounds pressure. The engine is of the triple expansion inverted direct acting surface condensing type, with cylinders 14, 22 and 36 inches in diameter by 24 inches stroke, and when running at 210 revolutions will develop 1,000 I. H. P. The cylinders are supported by four wrought columns at the front, and at the rear are cast iron frames into which is built the condenser. The circulating pump will be direct connected, 20 inches in diameter by 12 inches stroke.

The construction and equipment of this vessel will be of high class, and she will be built more on the lines of a yacht than those of the accustomed form of fishing vessel. This fact will be appreciated when it is stated that her block coefficient of fineness is but .48.

ELECTRIC IGNITION.—II.

BY DONALD M. BLISS.

The great advantage of the magneto type of igniter is in its permanent magnetic field, and the consequent ability to furnish a working current at comparatively low speed. It may also be run in either direction without any change in connections, so that when a reversing engine is used it is the only type of generator suitable for such a case.

The practical speed limit in a certain well-known make is from 600 to 3,000 or 4,000 revolutions a minute, a satisfactory spark being furnished within these wide limits. As the voltage, however, increases with the speed, there is danger of too heavy a current at high speed. The contacts deteriorate rapidly under these conditions. The best practice is to arrange the driving gear so that the average speed does not exceed 2,000 R. P. M.; in this way, if the engine has a normal speed of 300 R. P. M., it may be run as slowly as 125 R. P. M. and the magneto will still furnish a satisfactory spark. A well-made magneto igniter will stand a temporary increase of speed to 4,000 or 5,000 R. P. M. without injury. The writer knows of more than one case where a maximum speed was as high as 6,000 R. P. M. Under such conditions, however, the owner naturally wondered why the cylinder contacts required such frequent renewals.

The best method of driving these machines is by means of a properly arranged friction pulley running against the face of the engine flywheel. In the endeavor to secure constant speed, friction pulleys have been arranged with a governor device operated so as to vary the contact of the magneto pulley with the engine flywheel, so that a fairly constant speed is secured for the magneto, even if the engine speed varies widely.

These automatic devices operate on the principle of a centrifugal engine governor, and, while they are in quite extensive use, there are a number of joints and working parts necessary which introduce additional complications without securing corresponding benefit; for a good magneto generator, as stated above, should operate between widely varying speeds with good results.

A good friction pulley properly adjusted to a true-running flywheel is decidedly preferable to driving by a belt. If the latter method is used a flat belt is desirable, and the machine should be invariably provided with a sliding base or other similar device to allow of quick adjustment. Where the friction pulley is used it is necessary that the flywheel run truly, otherwise rapid deterioration will occur from springing of the armature shaft or rapid grinding away of the outer surface of the friction pulley.

It is also important to note that oil of any sort will quickly destroy rubber. Fiber friction pulleys are used quite extensively, and give good satisfaction when carefully adjusted and attended to. I believe, however, that in unskilled hands, and under the conditions that usually obtain in marine work, the rubber-covered friction pulley will be found most satisfactory.

Figs. 1 and 2 show representative types of magneto igniters. These two makes are now widely used and are coming rapidly into favor for marine work. They are, of course, designed on the same general lines, differing from each other only in mechanical details and arrangement of parts.

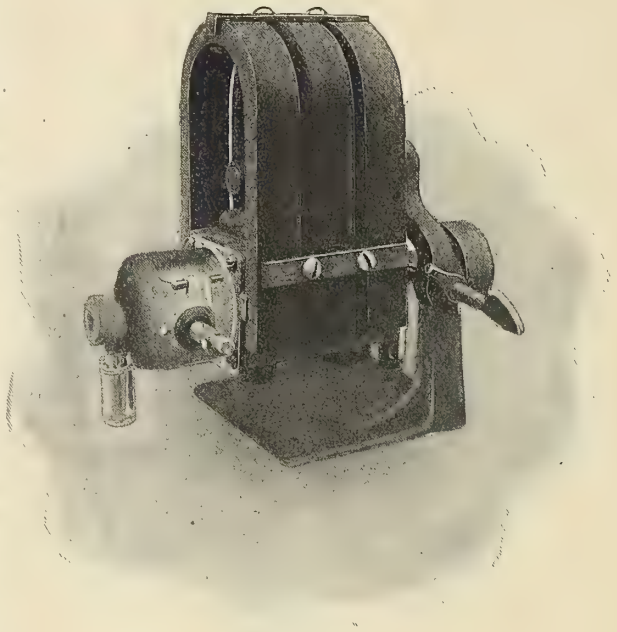


FIG. 1.

The magneto shown in Fig. 1 has the usual heavy, permanent magnet field with soft-iron pole pieces. The armature is laminated, slotted, and wound in a

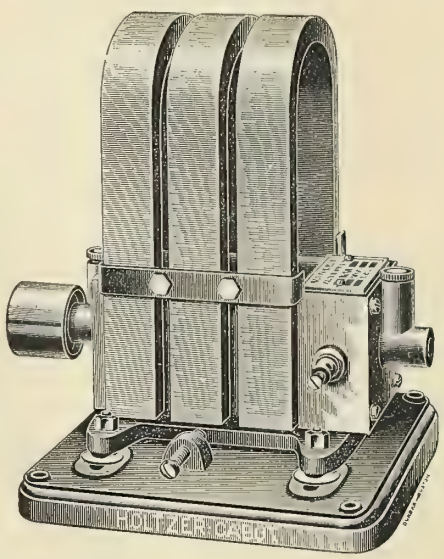


FIG. 2.

similar manner to the ordinary direct-current dynamo or motor. The commutator is of copper, and carbon brushes are used, so there is very little wear at this point. The distinctive feature of this magneto is a supporting and adjusting device. The machine is mounted on a strong pin on which it rocks. This permits of the belt being tightened if it becomes loose, or

the friction pulley adjusted by means of a thumbscrew provided for the purpose. The square base or pedestal is fastened to the floor or to a suitable shelf, and the adjusting screw inserted in the side toward the engine (in the case of a belt drive). This allows the igniter to be pushed away from the engine pulley so as to tighten the belt as it becomes loose. When it is desired to run the magneto by a friction pulley a spring can be attached to the bottom of the machine so as to draw it toward the flywheel, thus securing a good automatic adjustment and practically constant tension as the pulley wears away.

It will be noted that the armature, with commutator, is completely encased so that it is waterproof. It may

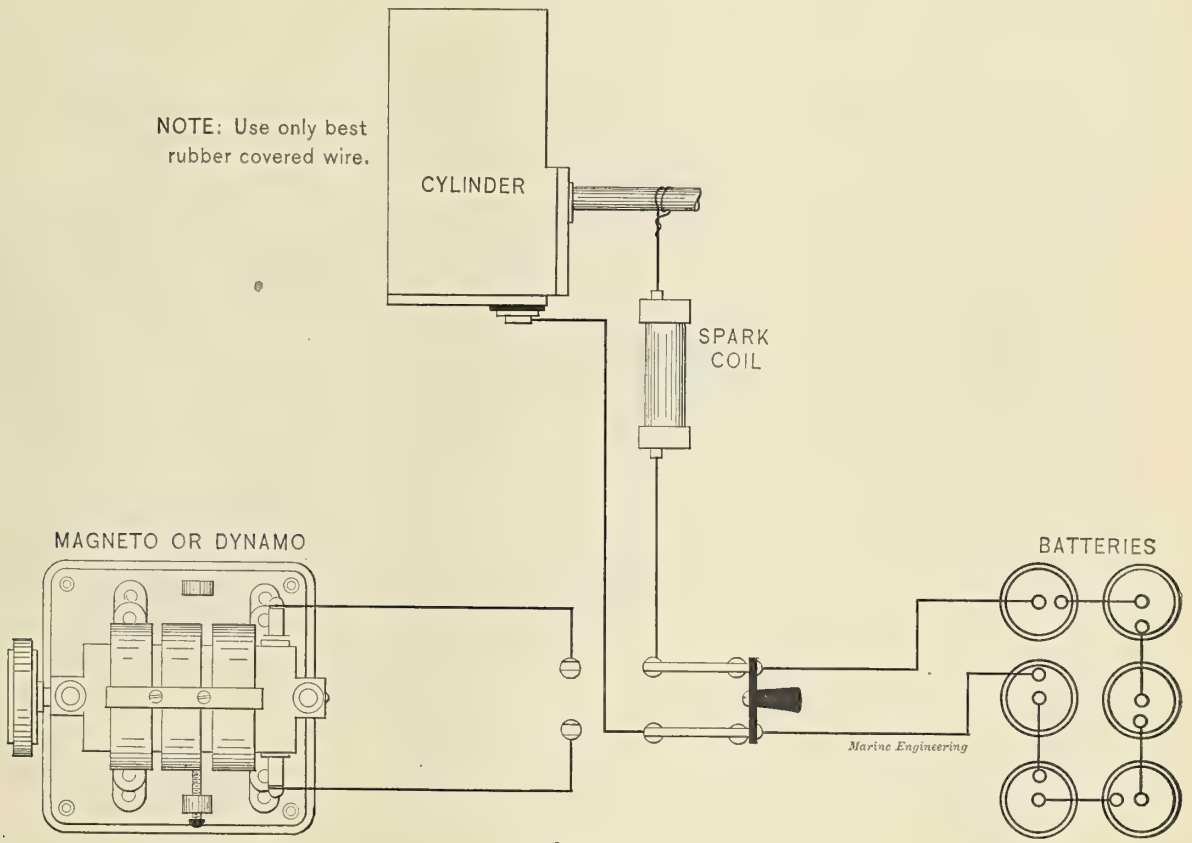


FIG. 3.

be run in either direction, and is therefore well adapted to two-cycle marine motors which are often reversed for backing the boat. It is fitted with automatic bottom-feed oil cups. These are provided with a spring and wick device, thus ensuring perfect lubrication. One filling of oil will last three or four weeks. The manufacturers do not claim that this machine is adapted for jump-spark work, but it gives good results in the wiping-contact system.

The machine shown in Fig. 2 is very widely used, and differs from the above in the following features:

The lubrication is effected by means of grease cups, and the lubricant used is the well-known Albany Compound, No. 2 Grade. The cups are provided with a loose pin, which reaches through the bearing and rests lightly against the shaft. The grease gradually feeds down the pin, and one filling of the cups should last two or three months.

The distinctive features claimed by the manufacturers of this machine are the powerful field, the armature wound with double silk-covered wire, and mica insulated copper commutator, securing a high insulation, and extra large square brushes. These are made of carbon with soft copper gauze embedded within, thus securing high conductivity with the good wearing and lubricating qualities of the carbon.

The belt-tightening or adjusting device, as shown, consists of double adjusting and clamping screws, by means of which the igniter may be moved in either direction on its base and securely clamped in position. The manufacturers are supplying these machines in certain sizes for jump-spark work with satisfactory results.

Fig. 3 shows a diagram of connections in which a few cells of dry battery are connected through a switch in such a manner that they may be used for starting the engine only; after it is up to speed the switch is thrown over to the igniter connections and the battery disconnected.

As stated in the previous article, good insulation is most important for successful operation in marine work. The wiring, switches, and other fittings should be of the best and most substantial construction, and high insulation maintained. For making the various connections the best quality of rubber-covered, stranded conductor should be used, not smaller than No. 12

B. and S. gage, owing to the ever-present vibration on the motor boat. A solid or single wire conductor is very liable to crystalize and break off where it is connected to the various binding posts, and, with the usual perversity of electrical devices, these breaks generally take place in concealed or inaccessible places.

It is not advisable to use the small wood-base button and lever switches usually offered by the dealer. Instead of these a small, porcelain base, double-pole, jackknife switch should be insisted upon.

While the spark coil and batteries may be placed under the seats or in some convenient locker, the switch should be placed in plain sight and within reach from the engine, so that when running at slow speeds, or for general manœuvering, it can be seen at a glance whether the engine is running from the battery or igniter, and the switch can be immediately operated without having to leave the engine. Automatic switches are now on the market, so arranged that as the engine reaches its normal speed the battery will be automatically disconnected and the igniter will be thrown in circuit. These switches are convenient, but as they are encased, and are not provided with an indicator, it is not possible to tell in cases of emergency whether the connections are on the battery or on the machine.

In making the various connections the wires should be carried under porcelain cleats or through well-insulated tubing; and where they are secured to the various binding posts, a few turns or spirals should invariably be made, so as to allow some slack wire for reconnecting in case the wire breaks off at the binding posts.

For multi-cylinder, high-speed engines it is not advisable to use the old-style long spark coils, owing to the time required for charging and discharging. Short, high-speed coils are now on the market at low price for that purpose.

Nine-tenths of the trouble experienced with magneto igniters is due to imperfect contact of the brushes with the commutator. This may be caused by a poor grade of carbon, or dirty commutator, or too weak a spring of the brush holder.

The front bearing cap of the igniter or the cover over the commutator should be removed every week or so and the commutator cleaned with a little gasoline, and if there are any signs of burning or blackening it must be repolished with fine sandpaper. A little attention to this matter of cleaning will usually save many vexatious interruptions in service.

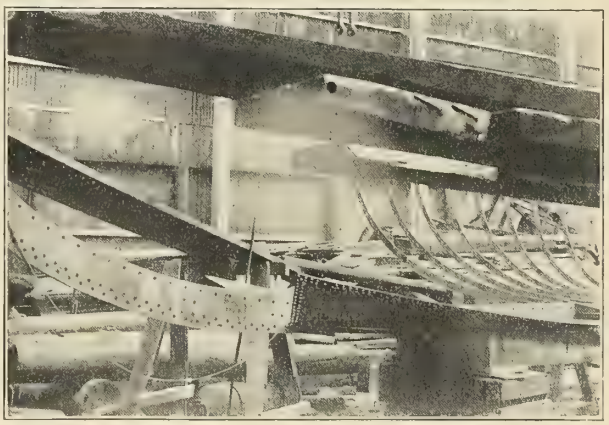
Under no circumstances should the armature be removed from the machine without first placing a heavy soft-iron plate or keeper across the bottom or poles of the magneto. If the armature is taken out without observing this precaution, the strength of the field magnets will be seriously reduced and the igniter will be put out of commission. In case this accident should happen, it will be found necessary to have the armature thoroughly remagnetized before it can be used again.

Electric Launch.—The Bureau of Construction and Repair are testing an electric launch made in the New York Navy Yard with a view of using this type of vessel for warships.

STEEL TOWBOAT VESTA FOR THE MONONGAHELA RIVER.

A steel-hull, stern-wheel towboat was recently launched from the ways of James Rees and Sons Company, Pittsburg, Pa. The boat was built under the supervision of Capt. Warren Elsey for the Vesta Coal Company, mainly for towing coal from the mines situated along the upper pools of the Monongahela river to the mills and furnaces of the Jones and Laughlin Company, Limited, at Pittsburg. Her length of hull from stem to after transom measures 135 feet. and over all, including wheel, 156 feet 6 inches; breadth, molded, 23 feet 4 inches, over nosing 24 feet 1 inch, with a depth of hold at frame No. 40 of 4 feet 6 inches. The sheer forward is 2 feet 10 inches, and aft 1 foot 9 1-2 inches, with a 6-inch crown of deck.

The transverse frames are of 3 by 2 1-2 inches, 6 1-2-pound angles placed 18 inches apart, carried up to top of gunwale, and composed of a short and long piece, the joints being 2 1-2 feet inboard from knuckle and alternating between frame and side of boat. The deck



VIEW OF STEM AND KEEL PLATE.

beams are 2 1-2 by 2 1-2, 5-pound angles spaced 3 feet, coming upon every other frame and fastened thereto with gussets. One of the accompanying pictures shows the stem, near the after end, slotted to receive the plating, and from there forward the plates are flanged and riveted as usual to sides. This arrangement is original with this company, also the boxes used along the bottom of bulkheads. The stern post is 2 inches thick by 8 1-2 inches wide at top and 5 1-2 inches at bottom. The radius of knuckles is 12 inches, and between them and the modeled bow and stern there is a dead flat. The thickness of hull plating is 5-16 inch on bottom, knuckles 3-8 inch, bow 1-4 inch, sides 7-32 inch, and decking of 2 1-2-inch white pine. The longitudinal seams and transverse joints are all double machine riveted. There are 5 cross and 3 longitudinal water-tight bulkheads of 3-16-inch plate, well stiffened with vertical angles extending from the deck beams to the frames. A stringer of 2 1-2 by 2 1-2-inch angles extends along at top, under the beams, for the full length of boat. At the bottom the bulkheads are made water-tight by means of the boxes placed between the frames and on the side opposite the vertical stiffeners. These boxes are made of plates flanged

on the lower side and at the ends, thoroughly riveted to bulkhead, frames, and bottom plating. A breast hook is placed at the bow, extending from stem to forward bulkhead and attached to the frames by gussets. Between the center and wing bulkheads there is a keelson of 3-inch Z-bar extending from the forward bulkhead to the main transom, secured to each frame by an angle-iron clip and to every deck beam by an angle-iron stanchion of 2 1-2 by 2 1-2 by 5-16-inch section. To stiffen the boat under the boilers, one of the cross bulkheads is placed at the forward end and another at the after end of boiler, properly reinforced with angles resting along the frame, while extra beams are placed on each side of the cross bulkhead supporting boiler sills.

As is the case in these hulls of shallow depth, two hog chains—one on each side of the boat—of 1 1-2-inch round iron extend from under forward end of boiler to stern over braces of 8-inch iron pipe. The ends of the chains are securely fastened to bottom of hull. This is somewhat of a departure from the usual custom, as white pine braces are generally used, but cannot be so serviceable in case of fire.

Occasionally—and it may be said, seldom with success, unless light duty is required—river steamers are built without hog chains, it being considered that the fore and aft bulkheads will keep the hull from "hogging." Even with chains, great care must be taken in the distribution of the weights. The usual tendency is for the boat to come up amidships, and to overcome this relief chains are so placed that the braces rest upon this part, with the ends of the chains taking hold under the main braces. The relief chain braces extend fore and aft only a short distance, and the tops of the braces go on higher than the under side of the boiler deck.

Three rudders are provided, the central one being balanced, or nearly so, the forward half being shaped to conform to the rake of the boat. In order to prevent drift and ice from getting between the rudder and the bottom of the boat, the latter is so curved that the rudder remains close in its full swing, which is about 45 degrees. The old wooden boats accomplished the same thing by having the bottom bustled out over the planking as the case required. So as to work uniformly, the two outside wing rudders are hinged to the skeg stern posts by means of heavy clevised hinges, having a long pinbolt running through the hinges and attached to the central one by a connecting bar. The rudder stocks are formed of 10-inch XX lap-welded tubing, having their sides flattened to receive the rudder plates, which are composed of two 1-4-inch plates laminated and reinforced with longitudinal stiffeners composed of 3 1-2-inch T-rails, closely riveted through the plates.

STEEL TOWBOAT VESTA, BUILT BY JAMES REES AND SONS COMPANY.

The cylinder beams are of an I-beam pattern and made of 1-2 by 26-inch web plate at the deepest place, and having a catenary curve reduction at the after end to 13 inches, having 8 by 5-8-inch top plates supported by 3 1-2 by 4-inch 9-pound angles, top and bottom, closely riveted. The shaft is of hexagonal section, 10 1-2 inches diameter, with 10 1-2 by 8 1-2-inch journals, and the cranks are shrunk and keyed on the shaft at 90 degrees. The cranks are 4 1-2 inches, tapered, bored for the wrists, and are also shrunk on from the inside.

The shaft carries four 48-inch steel wheel flanges, having pockets for thirteen 3 by 6-inch arms. The

flanges are first assembled in position by keying with wooden wedges on the flats of the hexagonal shaft. When all are in perfect alignment the wooden wedges are displaced by driving in iron wedges, thereby completing the mounting of the flanges on the shaft. The wheel, complete, is 19 1-2 feet diameter by 16 feet long, having 30-inch width of buckets, 1 1-2 inches thick.

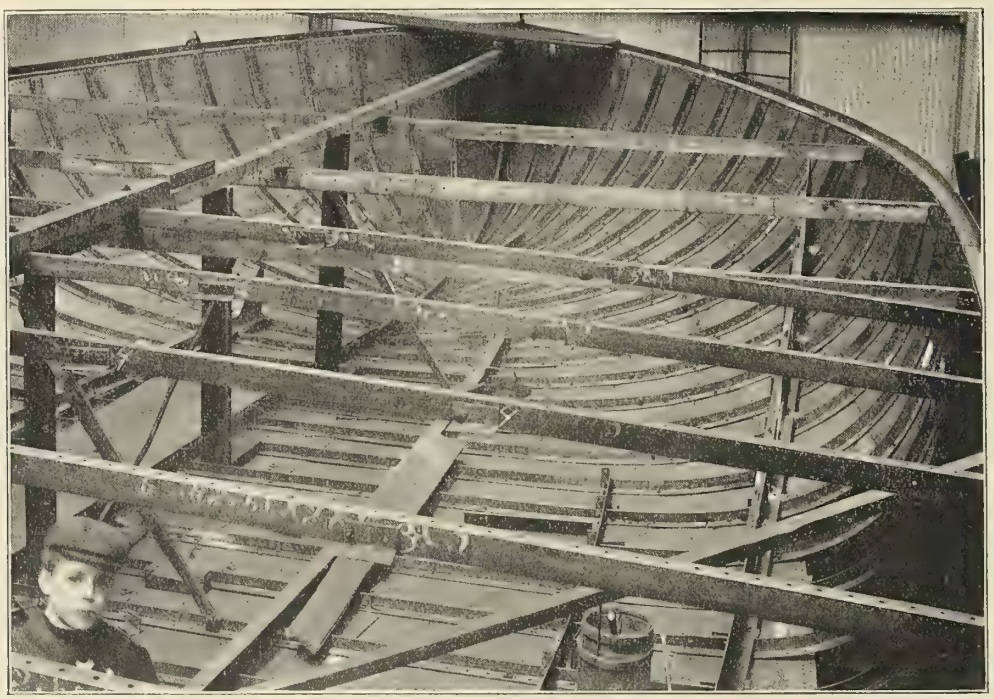
The engines are 400 I. H. P. tandem compound condensing, having one pair of engines on each side of the boat, with cranks connected at right angles. The high-pressure cylinder is placed forward of the low-pressure, mounted on the steel cylinder beams, the high-pressure cylinder being securely attached to the low-pressure by means of a separator and extending forward without any rigid support, but carried, by the flange bolts and equalizing springs, under the center of the same.

The dimensions of the cylinders are 12 inches diameter for the high-pressure and 24 inches for the low-pressure, by 6-foot stroke, the areas being in a ratio of 1 to 4. The steam is received at the center of the connecting pipe leading to the valve chamber, at which point it is controlled by a plunger valve, loosely attached to a button-head stem, reaching through a gland at the base of the housing frame and connecting a triphead carrying a swinging dog, lifted by a right-angle swinging lever in connection with the center arm at the center of the cylinder, which is given motion from the rock shaft. This motion is transmitted from a modern parallel motion taken from the pitman direct (not shown in the drawing), thus requiring no cam frames or eccentrics. The exhaust ports are controlled by a piston valve independent of the steam valve, as shown on the drawing. The cut-off motion is transmitted from a swinging pendulum trunnioned at the top of the column, supported by the slide of the engine, having an arm attached to a horizontal shaft at the top of the column. This shaft is pinned to a swinging pendulum, which is given motion through a thimble on the crosshead, giving variable graduations from 1-4 to full stroke of the engines. The cut-off is controlled by a system of shafts and levers leading to a pulpit quadrant, within the reach and control of the engineer at the throttle.

The piston heads are of the conventional type, having bull and snap ring, made of Homeo iron or semi-steel, a very superior material for the purpose. The piston rods are made of forged nickel steel, 4 inches diameter for the low-pressure cylinder and 3 inches for the high-pressure cylinder, all fitted with metallic packing. The large piston head is keyed to the rod, while the small head is forced upon a standard taper and held by a heavy and finely-threaded nut. The cylinder heads are designed to conform to the shape of the pistons, allowing about 4 1-2 per cent. clearance space. The shipping-up apparatus consists of two independent trunning cylinders, one on each side of the boat, mounted above and attached to the reversing forks, supported above by a tripod frame. The steam is received at the cylinder through the trunnion on one side, and exhausted through the trunnion on the opposite side. Trunnions accommodate the required radial motions and at the same time facilitate the pipe connections through the stuffing boxes.

The operating valve of the shipping-up apparatus consists of a four-way rotary valve, permitting the independent shipping of the engine, thereby enabling the engineer to lock his engine against the vacuum pressure when stops are made.

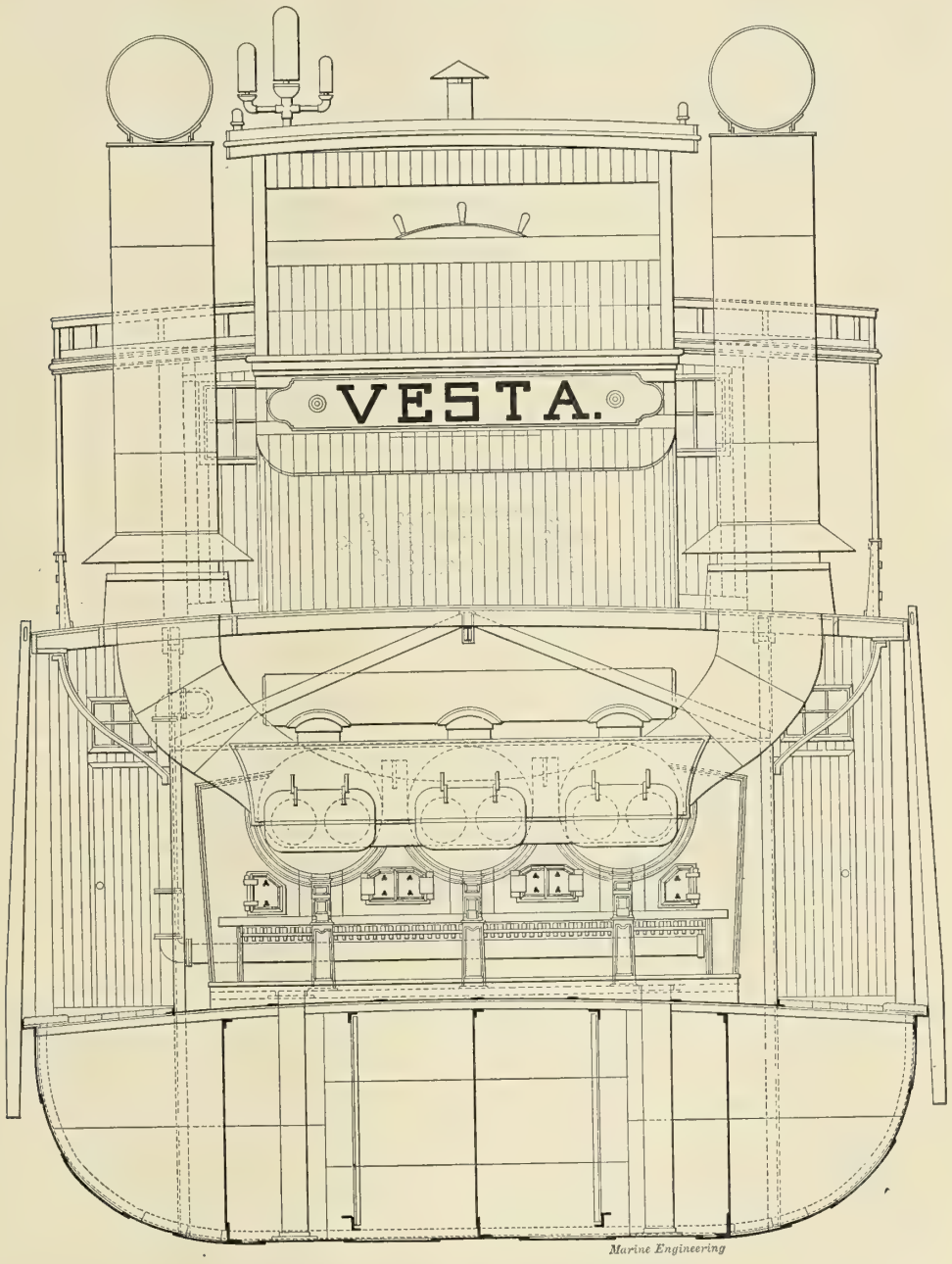
The condenser is of the surface Admiralty type, and is of the Wheeler Engineering Company's make, having



VIEW OF BOW OF TOWBOAT VESTA, SHOWING CONSTRUCTION.

600 5-8-inch tubes, giving 800 square feet of cooling surface. The dimensions are 2 feet 3 inches by 8 inches in length, mounted on cast-iron frames 24 feet high and securely attached by bolts to the deck. It is situated on the center of the deck over deck beams connected to the condenser by a 6-inch line, discharging into the hot well through a 3-inch line and maintaining quite a uniform vacuum of 26 inches.

The boat is also provided with a "nigger," a "doctor," and a "donkey."



SECTION THROUGH BOILER ROOM, STEEL TOWBOAT VESTA.

Nos. 56 and 58, and is supplied by a circulating pump, also of the Wheeler pattern, 8 by 14 by 12 inches, taking supply through two 7-inch suction lines leading from hull side about midships, with 34 inches diameter cylindrical well from whence the pump is supplied, and discharged through an 8-inch line to the condenser.

The air pump is also of the Wheeler pattern, 8 by 12 by 12 inches, situated on the port side of the hot well,

The "doctor" is a familiar name given to the boiler feed pump, and needs but little description here; however, it may be well to state that it is a Rees standard No. 3 doctor pump, having a capacity of 1,680 gallons per hour at a nominal speed of 15 revolutions.

The "donkey" is, likewise, a name given to a hand pump, consisting of two vertical barrels fitted with plungers and operated by means of a walking beam to

receive hand levers, and generally used for the purpose of washing the decks or the boilers when in course of cleaning them.

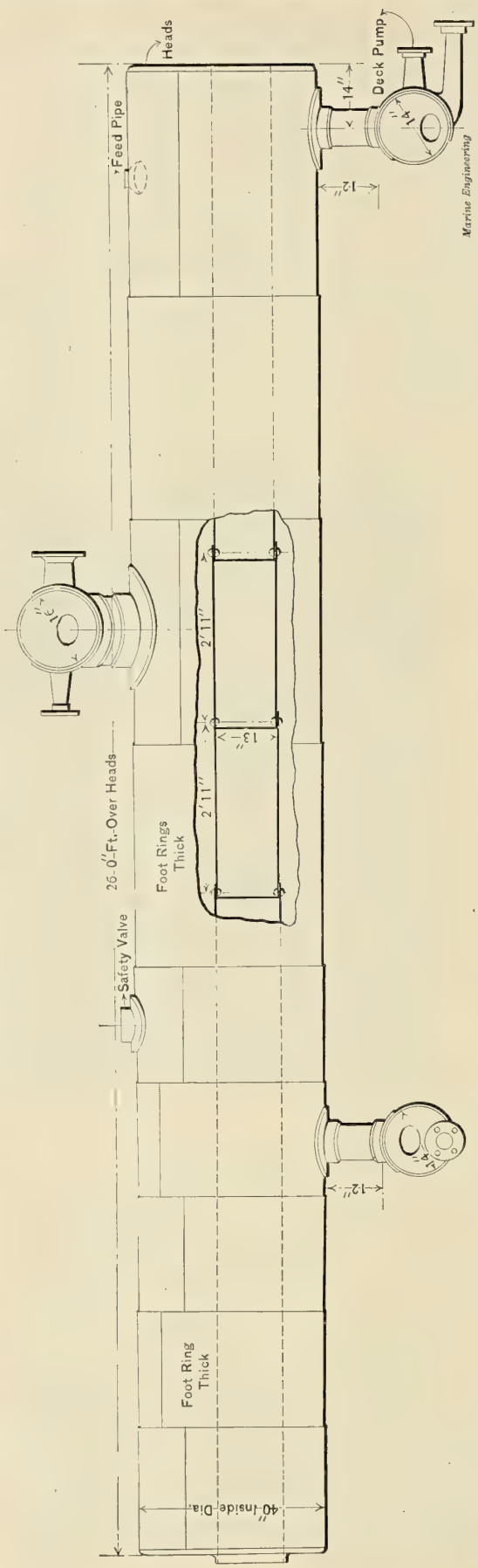
The "nigger," or capstan engine, is mounted on an A-frame constructed of 5 by 14-inch timber, standing 'thwartships on the port side and directly abaft the forecastle bulkhead on the main deck. It has a vertical shaft connected by a bevel gear, a similar horizontal shaft connecting the capstan under the main deck at the bow of the boat.

The "nigger in a box" is a type of small oscillating capstan engine mounted in a rectangular cast-iron box, standing about 12 inches high, operating a small winch barrel on top of the box by means of a worm and gear connection. One of these is placed on each side of the boilers, and they are used for drawing up the barge lines when making up tows.

The light plant consists of one Westinghouse direct-connected 17 1-2 K. W. multipolar, shunt-wound generator, with a Westinghouse engine having a capacity of 110 16 C. P. incandescent lamps throughout the boat, with two arc lamps on each side of the boat at the stern, and an 1,800 C. P. reflector headlight located on the forward boiler deck. This plant is situated forward of the condenser, or aft of the cross bulkhead at the deck room division. The engine is supplied with steam from the auxiliary steam line, having a Mason reducing valve, reducing the steam from 181 to 90 pounds pressure.

The boilers are of the conventional Western river marine two-flue type, with a shell thickness of .28 inch, 65,000 T. S. marine steel, and arranged in a battery of three, 40 inches diameter by 28 feet in length, and with two 13 1-2-inch flues running full length of each. The steam drum is 16 inches diameter by 10 feet 6 inches in length, supported by 13 1-2-inch legs, standing 8 inches above the boiler shell, flanged and double riveted through the shell, carrying on the inside a steel muzzle to provide against liability of the gage float entering the steam drum and closing up the openings. The boiler is designed throughout under the marine laws to carry a gage pressure of 181 pounds.

The boilers are supported at the after end by a 14-inch-diameter pipe, running horizontal and cross-connecting each boiler by 7-inch-diameter leg by 13 inches high, the whole resting on three cast-iron stands securely attached to an 8 by 12-inch steel-plate boiler sill. There is also a 4-inch-diameter mud drum extending across under the boilers and connecting each in a similar manner as the stand pipe. This drum, however, has no supports on the boiler deck, thus providing for expansion and contraction of the boilers. The forward ends of the boilers rest on a heavy cast-iron front set in a steel water-tight ash pan extending forward of the boilers and furnishing an ash chute connecting two 10-inch wells running directly through the hull of the boat, through which the ashes from the furnace are forced into the river by means of a 6-inch overflow line leading from the condenser. This line is also provided with an automatic valve, connecting and leading to a 1,300-gallon reserve tank placed at a short distance abaft the end of the boilers. The 16-inch steam drum referred to is provided with four steam line nozzles, as follows: Main steam, 5 inches; auxili-

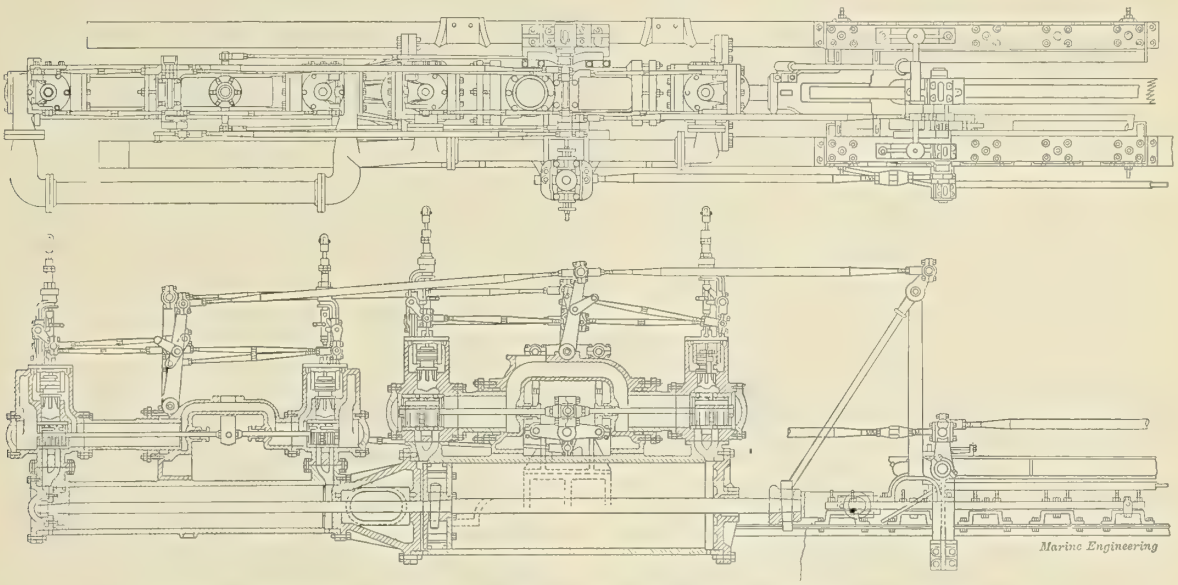


TWO-FLUE TYPE BOILER OF THE TOWBOAT VESTA.

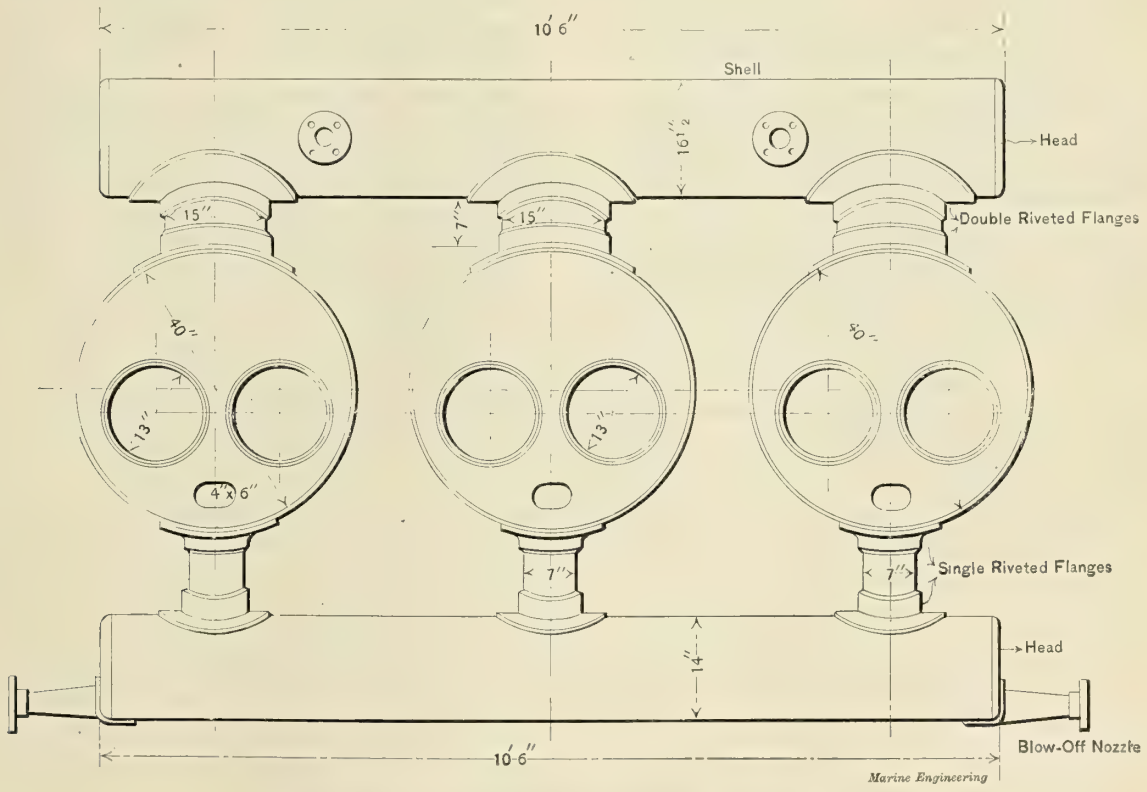
ary, 3 inches; and two 2 1-2 inches for capstan and siphon work.

The boilers give a total heating surface of 1,156 square feet, with a grate surface of 50 square feet, giving a ratio of 2.89 I. H. P. per square foot of heating surface. The coal consumption has been computed at about 19,000 pounds of run-of-the-mine coal each 24 hours, or 1.98 pounds per H. P. hour.

The rudders are operated by means of a steam steering gear having cylinders mounted upon an elevated frame at the after end of the boilers on the main deck, and are controlled by the pilot by means of a valve situated within his command.



PLAN AND SECTION OF ONE OF THE TWO COMPOUND ENGINES OF THE VESTA SHOWING VALVE GEAR.



ELEVATION OF REAR END OF THE BOILERS ON THE VESTA.

The width and height of towboats used in the two local rivers are necessarily narrower and lower than those of the Ohio, Mississippi, and many of their

tributaries. The large locks are 56 feet by 250 feet, and the smaller size 50 by 190 feet, and, to facilitate locking fleets through, the towboats are usually not made wider than the one in question. A barge may then be taken alongside through the small lock, if necessary. The draft, being increased by narrowing the boat, sometimes becomes a serious matter when the unimproved parts of the Ohio or Allegheny are navigated, and frequently this is made impossible during the low-water period.

The *Vesta,* heavily loaded as she is with compound engines, condensers, etc., draws 4 feet at the bow and 3 feet 6 inches at the stern when full coaled. Although it is considered that this boat is built unusually strong, she draws no more than other boats of wooden hull and same size in this district. This is due largely to the experience of the builders, the weight of the material being no greater than absolutely necessary. Some of the packets of greater beam do not draw more than 20 to 30 inches, particularly those navigating rivers or parts of rivers not slack-watered. To carry the weights imposed upon them, these stern-wheel boats are given full lines aft, which, by the way, are not conducive to speed. The *Vesta,* however, can make 10 to 12 miles per hour in the slackwater pools. The lines of this boat are similar to those of the stern-wheel steamers *Juniata* and *Braddock,* built by this company a short time since. The hulls of the latter boats were of wood. In the designing of these boats speed becomes a secondary consideration, power and light draft being the paramount requirements. With a nominal tow of five barges of coal containing 2,600 tons, or 65,000 bushels, however, the towing capacity of the boat is about 4,000 tons of barge coal. As to height, the *Vesta* is made to suit the conditions of the local rivers. Between main deck and boiler deck she is 10 feet, and between boiler deck and top of pilot house, 13 feet; to top of pilot house above water line she is 27 feet 6 inches, and at this height the stack is arranged for lowering by a winch. Most of the bridges on the Monongahela have not less than 50 feet clearance above the slack-water pools, but with a rise of 10 to 12 feet (beyond which little navigation is accomplished) some of the bridges in the Allegheny are not more than 30 to 35 feet above low water, and the necessity for low-built towboats is thus easily seen.

On the main deck forward is the coal bunker, with a capacity of about 1,000 bushels. Immediately aft of this is the boiler room, with a length of 48 feet; then comes the engine room, 62 feet long. The main deck house has a width of 24 feet.

In the cabin, beginning aft of the pilot house, there are 6 rooms for officers, each being in size 8 feet by 6 feet 3 inches, with 2 bunks each; then comes the mess room, and to this point there is a central passageway. Aft of the mess room are the kitchen, pantry, linen closet, bath room, sitting room, ice chest, and three rooms for the crew.

This firm has made numerous boats for South America, some for Mexico, and recently one was sent to China, the hull parts being carefully fitted together, then taken apart for shipment across continent and ocean. The boats built for Mexico were staunch enough to steam their own way across the Gulf of Mexico, after having passed the long distance down the Ohio and Mississippi rivers.

Not long ago a steel-hull boat for navigating the upper Yukon river of Alaska, of somewhat smaller dimensions, but in general design quite similar to the boats just described, was erected in the yards at Pittsburg, Pa., in material form, but in temporary or knock-down shape. All plates, frames, beams, stanchions, and other parts were carefully numbered and registered one with the other, thus providing for and expediting the re-assembling of the parts at the final destination. All the parts were bundled in light and compact form for shipment by rail to Seattle, Wash., thence by water to Skagway, where the entire cargo was transferred to small cars of the Yukon and White Pass Railway, which succeeded in delivering the material to White Pass, after many mishaps and delays, this being the end of rail transportation at that time. From White Pass it became necessary to transport, by means of pack mules and dog sleds, the whole cargo a distance of 39 miles over the ice and snow-covered mountains of Alaska to Lake Bennett, the final destination, and during the month of February, at a time when the mercury registered about 20 degrees below zero. The party encountered much suffering during some three weeks of this form of transportation from the end of the railroad to the destination at Lake Bennett. Finally, logways for the hull were laid on the beach at Lake Bennett, upon solid ice, after removing 5 to 7 feet of snow, and the work of reconstruction was begun by a force of skilled workmen under the supervision of Capt. P. Y. Ingaldsby and John Tarn. The boat was launched with boilers, machinery, and all outfit aboard within 35 days from the time of arrival of material. Her maiden trip was made over the lake through running ice, under the guidance of an Indian pilot, passing down through the White Horse rapids with safety, a feat, possibly, never before successfully accomplished by a steamboat of her dimensions. After passing through the rapids, her route was down the Upper Yukon river, loaded with passengers and general merchandise for Dawson City and the Klondike, returning with passengers and gold shipments.

Lake Superior Commerce.—All monthly records for freight tonnage through the Lake Superior canals were broken in July, when 5,082,298 tons were transported through this waterway.

Oil Fuel.—The Red Star Line steamship *Philadelphia* is at the yard of the Wallsend Shipway and Engine Company on the Tyne, England, where she is being fitted with oil-burning apparatus. If this system proves successful and economical, it is stated that the owners will adopt it in other vessels on their line.

Steamship Kaiser Wilhelm II.—On August 12 the longest steamship in the world, *Kaiser Wilhelm II.,* built for the North German Lloyd Steamship Company, was launched from the Vulcan shipyard, Stettin, Germany. The over-all length is 707 feet; beam, 71 1-2 feet 6 inches; depth, 39 feet; draft, 29 feet. The vessel is to be propelled by engines developing 39,000 horse power, which it is expected will give the ship the speed of 24 knots.

GAS ENGINES AND THEIR TROUBLES.—IV.

BY E. W. ROBERTS.

Gasoline.

Although widely employed as a fuel for heat, light, and power purposes, gasoline is a substance the properties of which are not generally understood. Quite a number class it with explosives such as gunpowder and nitroglycerine, while in point of fact gasoline alone is not in the slightest degree explosive. To secure an explosion in a gasoline engine, or anywhere else in fact, by the use of gasoline, it is necessary to have present a certain proportion of air. This is but one of the superstitions about this fuel which the writer hopes to dissipate.

To start at the beginning: Gasoline is the product of petroleum midway between benzine and kerosene, or rather it consists of a series which, in the selective distillation of petroleum, is obtained after the benzine

FIG. 18.

has been evaporated and before kerosene commences to be distilled. In the oil trade it is known as naphtha, being divided into three grades, A naphtha, B naphtha, and C naphtha, A naphtha being that last given off and hence having the greatest specific gravity. By the retail trade it is generally known as gasoline, and is sold according to its specific gravity, which is designated by so many degrees on an arbitrary scale known as Baume's scale. Stove gasoline having a specific gravity of 72 degrees Baume is that generally employed for gasoline engines, although gasolines from 66 degrees to 76 degrees may be used with success when employed with a vaporizer.

Petroleum and all the products derived therefrom belong to a family of chemical compounds known as hydrocarbons. The name comes from the elements hydrogen and carbon, of which there are a large number of different combinations. These vary from a light gas, as methane or marsh gas containing one atom of carbon and four atoms of hydrogen, down through heavier gases and then through a long series of liquids, starting with the petroleum ethers and ending with the heavier machinery oils. Following these come vaseline and the solids such as paraffine and finally coke.

Varying proportions of the two elements give substances having different physical properties. Naturally the greater the proportion of hydrogen, the less the density of the hydrocarbon. Quite frequently hydrocarbons having the same proportions precisely of the two constituents show different physical properties.

The origin of petroleum is interesting, particularly as the popular belief attributes it to the same source as coal. The latest investigations, however, point to an animal origin. In prehistoric times convulsions of the earth's surface caused the burial of large quantities of sea animals, principally of the mollusca. Disintegration followed without the presence of oxygen, the

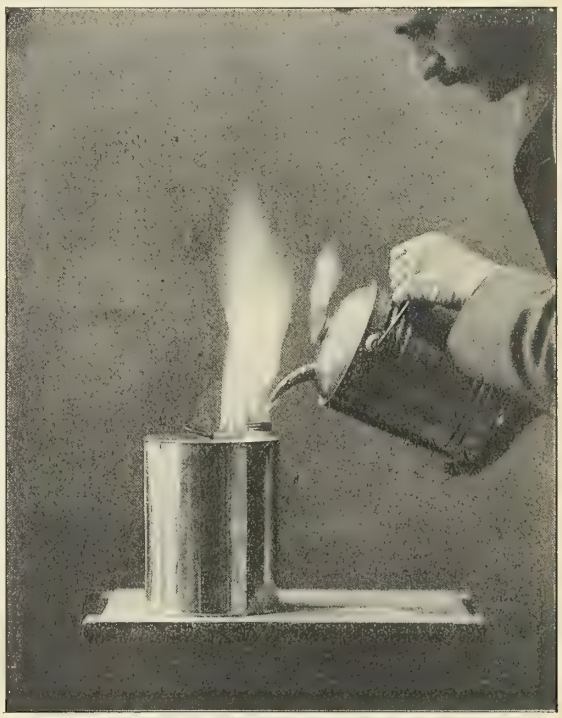


FIG. 19.

usual process of decay could not ensue, and the fleshier portions of these animals were finally transformed into petroleum, which finally settled into cavities and the interstices of the Trenton shales. The familiar term "coal oil" is therefore a misnomer, for, although hydrocarbons similar to the petroleum products have been artificially produced from coal, those in nature are undoubtedly of animal origin.

Passing from the general to the specific, the properties of gasoline will now be discussed. C naphtha, having a specific gravity of between 68 degrees and 78 degrees Baume, is quite volatile, vaporizing voluntarily at ordinary temperatures and boiling at temperatures ranging between 160 degrees and 260 degrees Fahr., according to density. The evaporation is so rapid at ordinary temperatures that a vessel partially filled with gasoline will soon drive all the air from that part above the liquid, so that it contains gasoline vapor alone. Since gasoline

vapor will not explode unless it has a certain proportion of air mixed with it, the contents of the vessel above the liquid are nearly always non-explosive. In order to illustrate effectively this and other properties of gasoline, the writer has performed several experiments before the camera especially for this article, the photographs being reproduced herewith.

In Fig. 18 is shown an ordinary gasoline can, nearly full, to which a lighted match is being applied at the opening. That the gasoline takes fire without explosion may be readily seen by the large flame above the opening, the result being practically the same as lighting gas at a jet. No explosion could possibly follow in this case, as there is no air in the can, and a close inspection shows, before the match is applied, that vapor is slowly issuing from the can.

In Fig. 19 is shown a seemingly dangerous operation, in which half the contents of the can in Fig. 18 has been emptied into another receptacle and the vapor lighted at the opening. To accentuate the flame a small quantity of gasoline has been poured on top of this can. Gasoline is being poured through the flame into the can, as is plainly shown in the photograph. This experiment may be performed with impunity, the only precaution necessary being to keep the hands out of the way of the flame so as not to scorch the fingers.

In Fig. 20 is shown a can from which is issuing a tiny flame, the vapor burning as it passes from the can. The writer is about to extinguish the flame with his handkerchief, showing a simple but effective method of extinguishing a fire on the top of any vessel containing gasoline. In fact two or three smart blows in rapid succession with the bare hand will accomplish the same result without the slightest inconvenience. This was the method employed in extinguishing the flame after the experiment shown in Fig. 19, the blow of the hand on the filling hole at the same time extinguishing the flame at the spout because of the forcible ejection of the vapor, driving the flame too far away for it to get back. The blazing gasoline on *top* of the other can soon burned itself out, and a blow of the hand was sufficient to extinguish the tiny flame remaining at the opening.

The ensuing illustrations show experiments made at the instance of the advisory editor of MARINE ENGINEERING, and are to disprove the popular superstition that a lighted cigarette or a lighted cigar will ignite gasoline or its vapor. In Fig. 21 is shown a lighted cigarette which was smoked furiously for a moment, in order to secure a very bright spark, and then held over the opening of the can. At the time the photograph was taken the cigarette had been held in the position shown for fully fifteen seconds. The writer has tried this experiment a number of times, both in the manner shown and by holding a cigarette or a cigar in an explosive mixture of gasoline and air. In no instance was it possible to secure ignition.

In Fig. 22 the writer is seemingly very brave, smoking a cigar at a rapid rate with the burning end held over the opening of the can. The ashes had been carefully knocked from the cigar, so as to give the vapor the greatest possible access to the burning tobacco. In the photograph the smoke issuing from the cigar is plainly visible, although the writer is uncertain whether it will reproduce in the half-tone.

In Fig. 23 the small cup is filled to the brim with gasoline, and the photograph is taken just as a brightly-

FIG. 20.

burning cigar is plunged therein. The result is exactly the same as if the cigar were to be plunged into water.

FIG. 21.

The spark is extinguished with considerable sputter and the generation of quite an amount of vapor.

The cigar shown in Fig. 24 has first been lighted and then thoroughly saturated with gasoline. The cigar is a

fresh one, yet the writer smoked it to within an inch of the end without a flame appearing, although the "snipe" contained a considerable quantity of gasoline, and immediately burst into flame on attempting to relight it with a match. Perhaps this would not be a very pleasant experiment for the average individual, but the writer may say that he is quite accustomed to the taste of gasoline, and, with the exception of a possible slight tendency to light-headedness, suffered no inconvenience whatever.

I have just received from Prof. Durand a clipping containing an account of the recent explosion on the *Lucy R,* which the newspapers attributed to the tank taking fire from the spark of a cigar. This would seem a contradiction of the results obtained by the previous experiments, but the writer believes that, if the truth were to be told, the cause of the explosion was an entirely different one, and that this part of the story had its origin in the brain of the reporter.

This story reminds the writer of the explosion on the *Fulton* some two years ago on Long Island Sound. This explosion has been quoted by the manufacturers of an engine using kerosene as a fuel as a "new and disastrous proof of the exceeding danger accompanying the use of gasoline." In regard to this explosion a gentleman has written me as follows: "The explosion on the *Fulton* was not due at all to gasoline, but to hydrogen gas originating from the storage battery." Incidentally it may be mentioned that the explosion on the *Fulton* was at the time attributed to a lighted cigarette. Although the writer has not had an opportunity to try a lighted cigarette on hydrogen, he does not believe that even this lightest of gases can be ignited in this manner. This opinion is founded upon the statement of Mr. Percival Spencer, of London, a balloonist who has, in all probability, made more ascensions than any man living. In reply to a question propounded by the writer, he stated that, so long as a cigar had been lighted before entering the car of a balloon, there was no danger of igniting the gas from that source.

One often reads of a balloon exploding by catching fire. This is a popular fallacy, for, although several balloons have caught fire, there is no record of a balloon explosion following such a disaster. If the neck of a balloon is tied tight and it is sent to an extreme altitude, the rarefaction of the air will cause the balloon to explode simply on account of excessive pressure of the gas contained in the envelope. A conflagration, however, does not necessarily follow.

A parallel case to the above is found in a tightly closed vessel containing gasoline which is exposed to an excessively high temperature. The heat will generate vapor, just as steam is generated in a boiler, and the vessel will explode in the same manner as the balloon, but unless a flame is in the immediate neighborhood the vapor will not take fire. As an instance the writer remembers a benzine can which exploded in the above manner in a printing office, but no fire followed.

Many so-called gasoline explosions are really nothing more than gasoline fires, starting usually with a receptacle catching fire and then being upset by some excited person. Nevertheless it is quite possible to produce a gasoline explosion, as the following instance will illustrate: In the factory where the writer is employed a workman was testing out a gasoline tank with water. No gasoline had been in the tank for ten days, except what little remained after the tank was emptied. Wishing to solder the tank, the workman stepped to the forge to dry it. In a moment there was an explosion; the tank was flattened out, but, fortunately, the workman escaped injury. As it requires but 124 volumes of gasoline to 1,000,000 volumes of air to make an explosive mixture, it will be seen that a gasoline tank must be nearly dry to contain an explosive mixture.

FIG. 22.

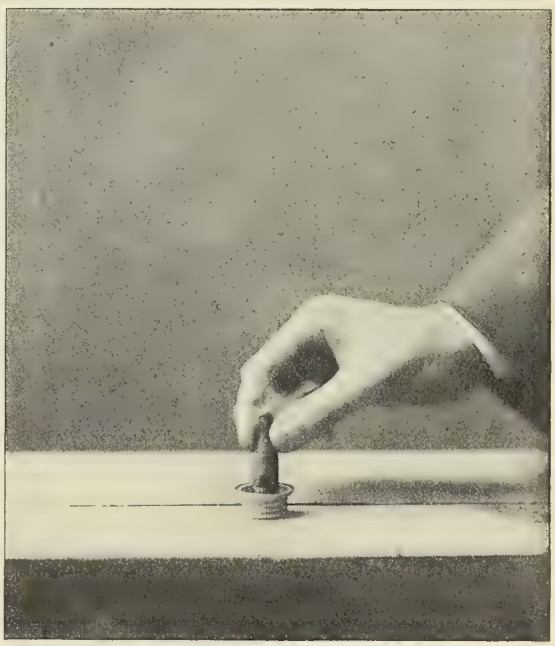


FIG. 23.

In a boat driven by a gasoline engine precautions

should be taken to avoid leaks into the locker spaces and all enclosures where a very small quantity of gasoline is likely to become mixed with a large proportion of air. If the engine room is enclosed it should be well ventilated, as should the space around the gasoline tank and all spaces where gasoline is likely to enter. Gasoline should be led from the tank to the engine through a lead pipe, all joints of which should be sweat joints, well made. Besides the convenience of lead pipe for passing around corners, it is not so likely to spring a leak as other materials when it is subject to strain or some heavy object is dropped upon it. If a leak is found, stop it absolutely, as a leak partially stopped is very likely to be worse than if it had been left alone; for a small quantity of gasoline is more likely to cause an explosion than a large one.

FIG. 24.

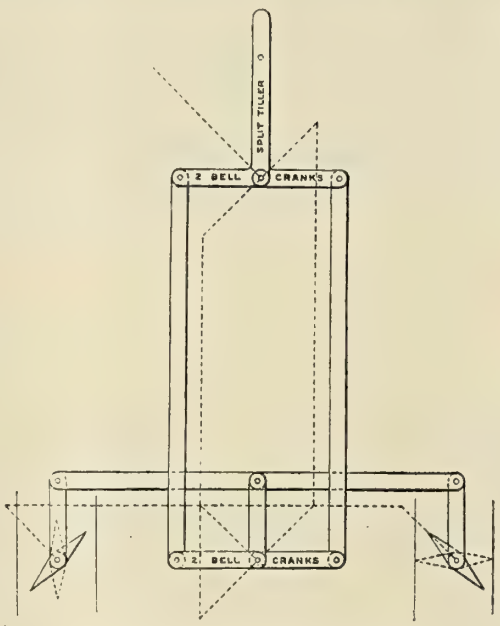
If, by any mischance, gasoline takes fire and a fire hose is available, use it so as to wash the burning gasoline into the sea, and get away from that portion of the water on which lies the burning gasoline. This should never be done, however, if the burning gasoline is liable to be carried on top of the water to other inflammable property, unless it is absolutely necessary to save life. A gasoline fire of small proportions may be beaten out with a blanket or a coat, but a much better extinguisher is flour, which will float on top of the liquid and smother the flame. Sand or loose earth will also answer the purpose, but, as it sinks to the bottom of the liquid, it is not quite so good as flour. A bottle of strong ammonia thrown into an enclosure in which gasoline is burning, or in fact any fire, will often prove a very effective extinguisher. Chemical fire extinguishers are also much better than water, and they should be invariably carried in a gasoline launch of any proportions.

In conclusion the writer would say that the so-called dangerous properties of gasoline are to a great extent purely imaginary and have no existence in fact. With ordinary care a gasoline engine is not nearly so dangerous as a steam boiler, and does not require nearly the attention necessary in the care of the latter to prevent accident. This statement is amply verified by the exceedingly small number of accidents that have occurred to the power plants of gasoline boats from the gasoline itself.

(To be continued.)

Steering Gear for Twin-Screw Vessels.

The accompanying diagram is a device patented by Mr. V. de Michele, of Rochester, England, for steering twin-screw steamships. The plan consists in fitting a special throttle valve to each set of engines, and connecting these throttle valves by bell cranks and linkwork to a tiller, as indicated in the diagram. With the tiller in the central position, each engine receives an equal supply of steam; but on moving it over, as indicated by the dotted lines, the valve throttles the supply to one set of engines, causing them to run more slowly, and so steering the ship. The tiller is split in halves; normally these halves are connected by a pin dropped through the hole shown, so that they work together as a single piece; but by removing this pin one half can be put hard over one way, and the other hard over the other, opening wide or closing both the valves, as may be desired by the steersman.



NEW STEERING GEAR FOR TWIN-SCREW SHIPS.

Monthly Shipbuilding Returns.—The Bureau of Navigation reports 106 vessels of 28,209 gross tons built in the United States and officially numbered during the month of July, 1902. The largest steel steam vessels included in these figures are: The *Harold B. Nye, A. E. Stewart, Panay, James H. Hoyt,* and *Thomas Adams,* aggregating 20,000 gross tons and all built on the Great Lakes.

Hospital Electric Launch.

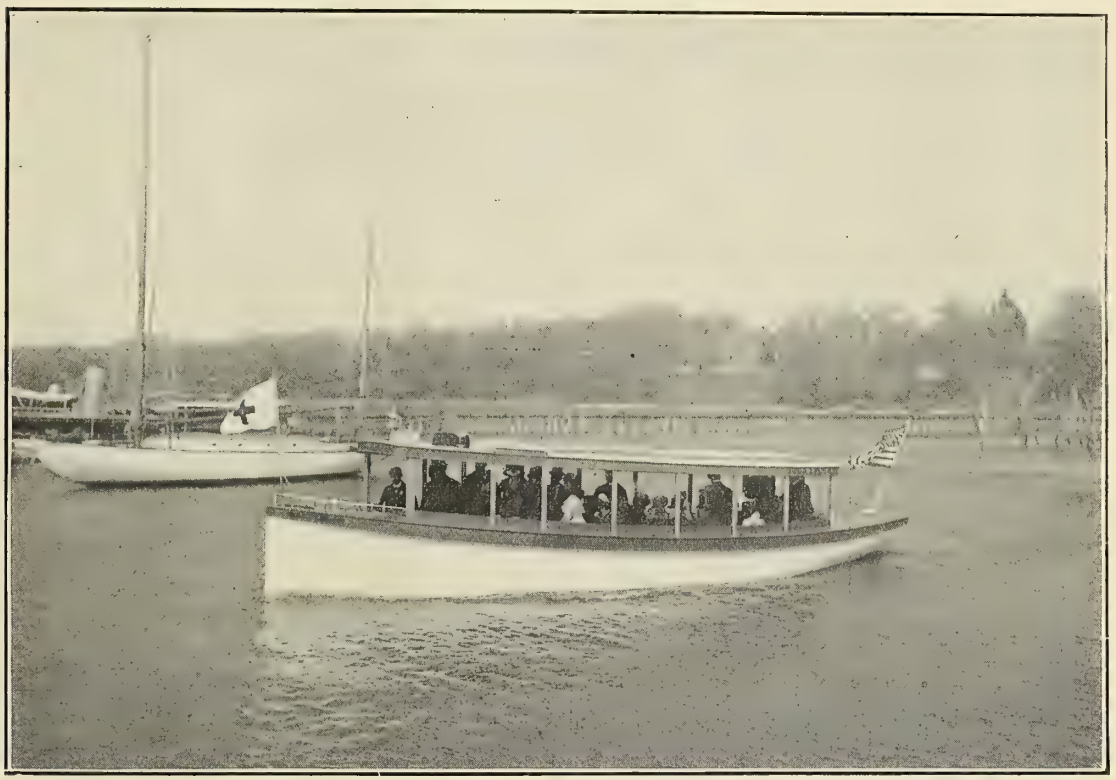
A novel craft has recently been completed by the Electric Launch Company, of Bayonne, N. J., to be used for the St. John's Guild, New York city.

The accompanying plans and engraving exhibit the general type of the vessel, and the description of the hull and the principal dimensions are as follows:

Length over all, 38 feet.
L. W. L., 35 feet.
Beam, 9 feet.
Draft, when loaded, 2 feet.
Freeboard amidships, when loaded, 2 feet 6 inches.
Length of forward deck, 6 feet.
Length of after deck, 7 feet.
Head room under carlins of roof, 6 feet.
Two side entrance hatches, 2 feet by 2 feet.
After hatch, 8 feet by 5 feet.

The launch is designed especially for transferring sick children between the floating hospitals of the St. John's Guild and the Seaside Hospital at New Dorp, Staten Island, the floating hospital barges anchoring about a mile off shore on account of shoal water. The boat has seating capacity for 40 adults or 60 children. It is the first electric ambulance launch ever built. Power for refilling the batteries when exhausted is obtained from the electric-lighting plant of the Seaside Hospital, one man being all that is necessary to operate, charge, and care for the launch.

The boat is finished in white enamel and has three entrance hatches and a wide stretcher hatch making an opening in the roof so that a full-size stretcher can be lowered from the hospital barge directly into the launch without disturbing the occupam



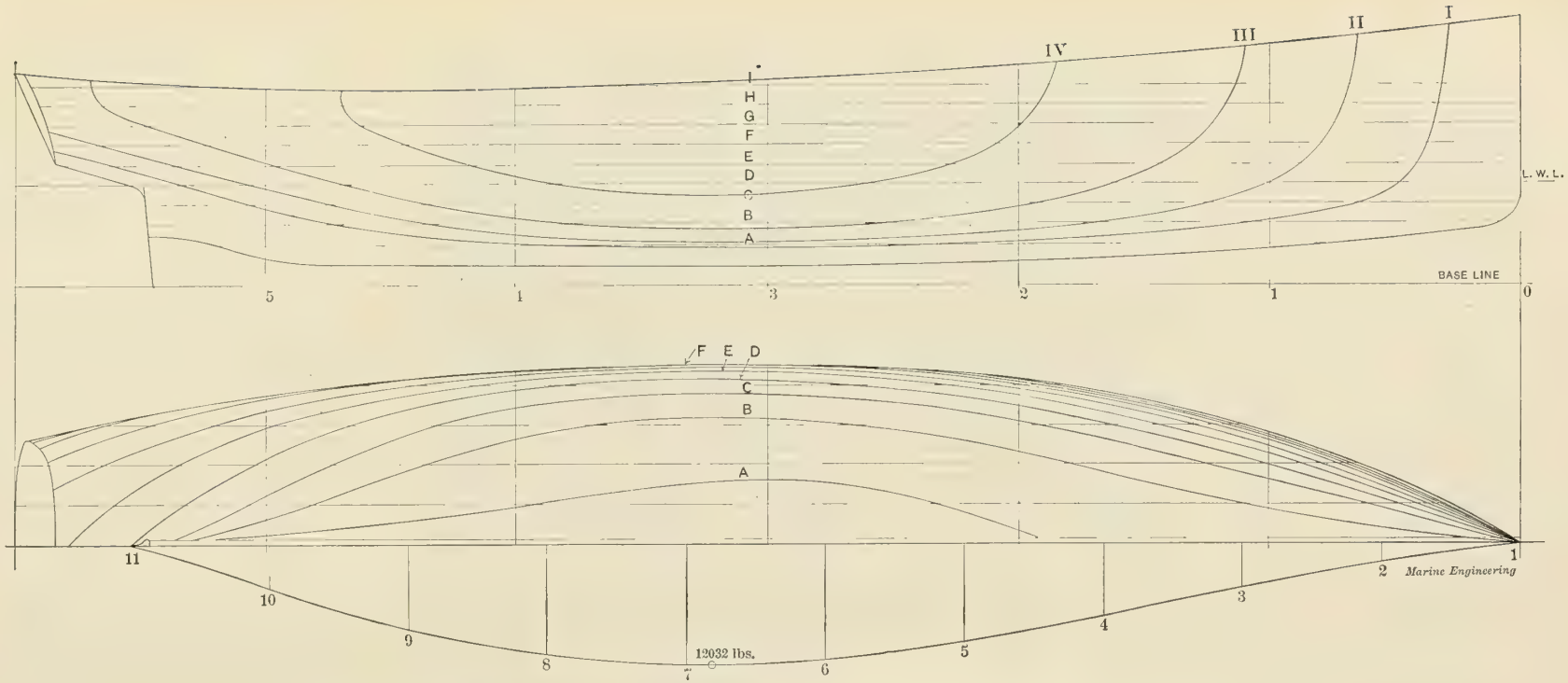
HOSPITAL ELECTRIC LAUNCH MARGARET FOR ST. JOHN'S GUILD.

The keel, shaft log, stern timber, transom, transom knee, and forward deadwood are of white oak, copper bolted, and riveted on rings. The keelson is of yellow pine and the frames are of oak, steam bent and spaced ten inches between centers. The floors are also of oak, sawed with natural crooks at the ends. The clamps are of yellow pine. The planking is laid with one-inch cedar, copper fastened and wood plugged; the bilge clamp is of yellow pine, and the shelf of the same material. The shear strake, plankshear, and moldings are of oak. The seams are calked with cotton, paved and puttied. All butts are cut between timbers and riveted to oak butt blocks. The breast hooks and upper knees are of oak, and heavy oak rubbing strips are placed on each side of the launch at the edge of the plankshear, and are protected by iron.

The cockpit is level throughout and laid with tongue-and-groove pine, supported upon oak floor bearers, with provision for batteries and motor under same. The sides of boat in cockpit and forward of bulkhead are ceiled in yellow pine above the floor line. Slatted seats, which extend around the side, are also of yellow pine.

The roof covers the entire cockpit, is strongly built and supported upon oak stanchions and carlins. The ceiling is of white pine, the roof is covered with canvas, sized and well painted. The sides are closed by roller storm curtains of the street-car type for protecting the occupants from the sun and storm.

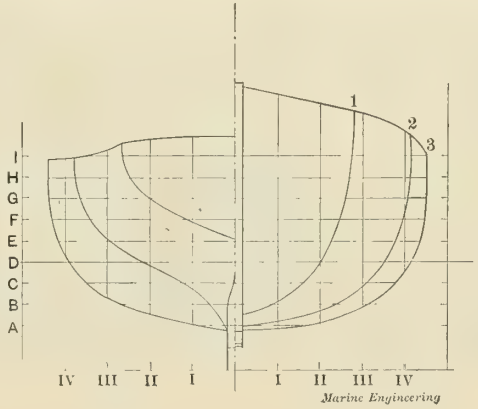
The power of the boat is supplied by an 8 H. P. electric motor, which is placed beneath the flooring and is directly connected to a Tobin bronze propeller



WATER LINES, BUTTOCKS, AND BODY PLANS OF THE HOSPITAL ELECTRIC LAUNCH.

shaft. All the bearings are self-lubricating, and a thrust bearing of the ball type is fitted. There are eighty-four "Chloride Accumulators" of the 9LL type. The elements are placed in patent hard-rubber cells with tight-fitting wood covers, and all are stored under the flooring of the launch, resting upon patent porcelain insulators, giving air space around each battery.

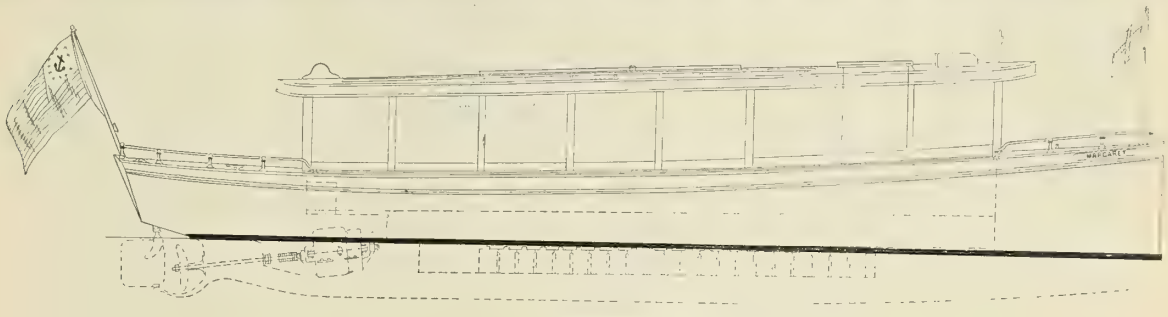
The controller is placed under the forward deck and operated by a shaft extending through the steering wheel bearing. By means of this controller five different speeds ahead and two reverse speeds may be given to the motor. The speeds of this launch, by actual test, are given below. The hours to run and total miles covered are by calculation.



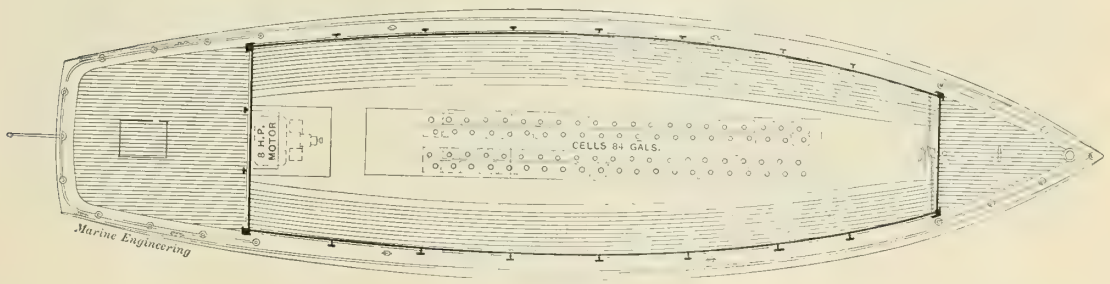
Controller.	Speed Miles per Hour.	Hours to Run.	Total Miles Covered.
1	5.75	14	72
2	7.05	10	70 1-2
3	7.93	5	39.65
4	8.61	3 1-2	30.13
5	8.97	For fifteen minutes.	

The *Margaret* was launched with full power equipment and was propelled under its own power immediately after touching the water. It is a gift to the St. John's Guild by Mr. Isaac N. Seligman, of New York.

The Syren and Shipping.—The day for new marine papers seems to be at hand, judging from the several new publications which have recently appeared on our Atlantic and Pacific coasts. The latest one to be introduced to the public is the American edition of *Syren and Shipping*, illustrated. *Syren and Shipping* has for many years held a leading position in English maritime affairs, and so successful has it been on the other side that the manager has decided to open an American edition, the form of which will be closely along that of the home paper. It is stated that the contents from week to week will include illustrated articles, description of principal harbors and docks, shipyards, tools, etc. Leading articles will be written by experts on subjects of maritime interest; the editorials will take up current topics. Under the headings of "Ships that Pass in the Day," "Syren Observatory," "Sidelights on Shipping and Commerce," "On and Off the Ways," "Marine Insurance Notes," "Shipping and Finance," "Wall Street," "Freight and Fixtures," "The Produce World," "Black Diamonds," "The Iron and Steel Trade," are promised much interesting news and description. The head office of the American edition is 313-315 Maritime Building, New York city. The paper will appear weekly, on Saturday. Domestic subscription price is $5 and the foreign $6.50.

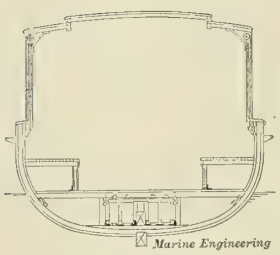


SHEER VIEW



PLAN

PLAN ELEVATION AND SECTION OF HOSPITAL ELECTRIC LAUNCH.

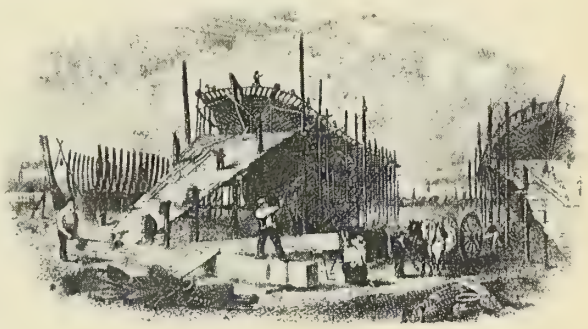


Old Shipyard.

Editor MARINE ENGINEERING:

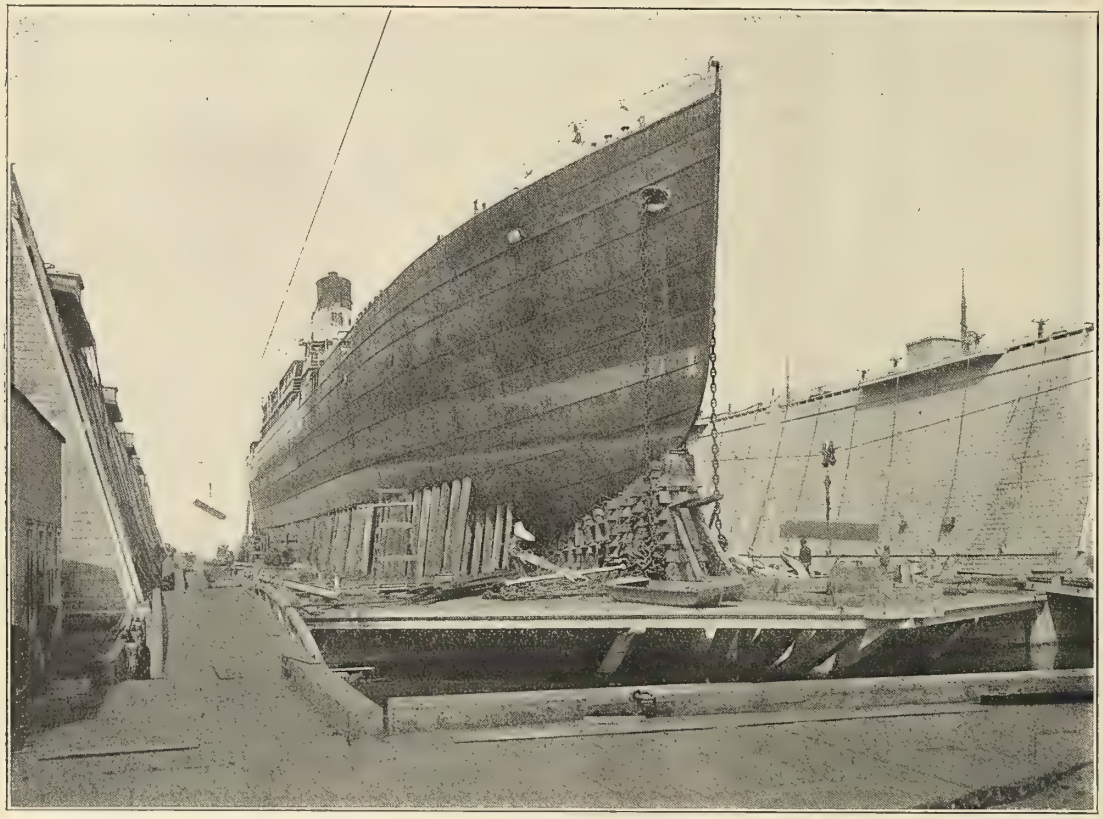
You have published on several occasions pictures of modern shipyards. Perhaps, therefore, it will interest you to see a shipyard of the old times.

A few weeks ago an old bank building in New Castle, Maine, was torn down, and there was found tucked away in a forgotten corner an old bill issued by the New Castle Bank when it was a State bank. The bill was old and discolored with age. It is supposed that the engraving was made some time before 1840. The accompanying engraving shows the picture on the bill of what was apparently a typical shipyard on the coast of Maine over half a century ago. S. E.



VIEW OF OLD SHIPYARD IN MAINE.

Lake Shipbuilding.—The ships already ordered from the American Shipbuilding Company for 1903 delivery will cost in round numbers $8,000,000. This amount will undoubtedly be increased.



THE U. S. TRANSPORT M'PHERSON IN THE MORSE IRON WORKS SECTIONAL DRY-DOCK, SHOWING EXTENSIVE SHORING.

Building a New Bottom for a Wrecked Ship.

As will doubtless be remembered, the United States transport *McPherson* went ashore in 1898 on the southern coast of Cuba, not far from Cardenas. She struck on a ragged ledge of rock, and many attempts to pull her off proved unsuccessful. Succeeding storms battered the ship until her entire bottom was broken up. After several months of arduous work, contending with many storms, the Merritt-Chapman Wrecking Company, New York, succeeded in floating the *McPherson* and towing her to New York. The wreckers had undertaken the work with the understanding that if she were not salved they would get no pay, and as weeks passed by and the vessel was not floated, but daily becoming worse, the Government was not anxious to have her salved.

When the ship first struck, tons of the pig iron ballast were thrown overboard to lighten her. This ballast was thrown on the off-shore side of the ship and thus, in a measure, acted as a barrier against floating the vessel. However, by building several cofferdams in the hull, patching up the holes and filling the bottoms with tons of cement, the water was pumped out and the ship floated.

In towing the *McPherson* to New York a heavy storm was encountered, which broke the tow line, and again the ship drifted on shore. She was, however, finally brought to New York and docked on the new floating sectional dry-dock of the Morse Iron Works, South Brooklyn. Inspection showed that the bottom plating and framing was broken from the stem to within 100 feet of the stern. When the ship was put up for auction the only bidder offered $12,000. The Government decided not to sell her at this figure, and she remained several months moored at the shipyard and kept afloat by continuous operation of wrecking pumps.

After several months the Government decided again to sell the ship, and she was knocked down to the Luckenbach Dredging Company of New York for about $10,000. The purchasers gave the job of repairing her to the Morse Iron Works, and she was shortly after docked for the most extensive repairs to the hull of a ship ever carried out in this country.

Owing to the condition of the bottom, no keel blocks and but few bilge blocks could be used in docking the vessel, and the method of supporting her by shoring is clearly shown in the accompanying illustrations. The form of floating dock was especially adapted for docking such a vessel as this, because of its elasticity.

The condition of the bottom is clearly shown in the illustrations on page 471. The *McPherson,* formerly the German ship *Obdam,* is one of the old type of English-built steamers, 460 feet long and but 40 feet beam. This exceptionally small beam gave her greater longitudinal strength, which probably accounted for her holding together as well as she did. Her bar keel was bent upward into the hull at a point about 40 feet from the stem, and from there aft the frames, plating, and all longitudinal and transverse members were broken and twisted. It was necessary to build an entire new bottom from bilge to bilge. The hold stanchions had

What Remained of the Bottom Forward of Boiler Room, Looking Forward.

Damage Under Forward Collision Bulkhead, Foot of Stem at Center of Picture.

VIEWS OF THE DAMAGED BOTTOM OF THE U. S. TRANSPORT M'PHERSON.

been jammed up through the lower deck, and many of the deck beams, besides all these stanchions, were replaced. Several bulkheads were also rebuilt. The boilers were shored up from the dock and the bent bottom cut out underneath them. The engine-room bedplate was broken and most of the bottom below the engine room was also rebuilt. The engine was completely dismantled and all parts taken to the shop. The shafting had been twisted out of line, but the same sections were used over again. Aft of the engine room the damage was not so severe as it was in the fore body, but a new stern post and rudder had to be fitted.

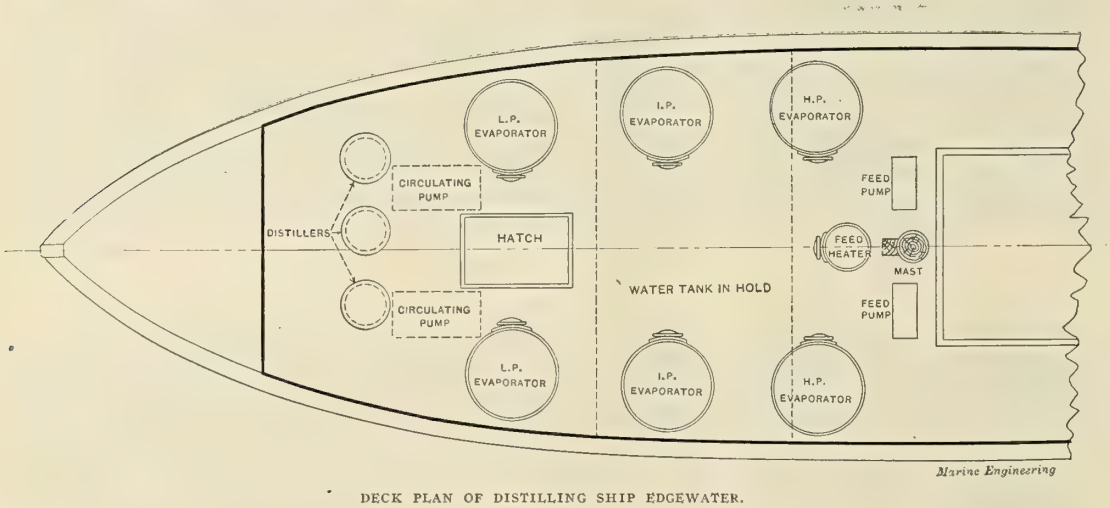
All this work was completed in the remarkably short time of six weeks. The cost of repairs to the hull alone amounted to about $80,000. One appliance which greatly facilitated the work is the overhead trolley, erected on either side of and extending the length of the dock, as seen in the view on page 470. By this means the plates and members were quickly removed from under the bilges, taken to the yard, and new plates returned. This kept the dock comparatively clear. The system was designed and installed by the Morse Iron Works.

As the vessel neared completion, a most interesting and bitter contest, concerning the securing of an American registry for the ship, started between the owners on one side and the San Francisco and Hawaiian Steamship Company on the other. The owners claimed that as the vessel was flying the United States flag, was owned by the United States Government, and was wrecked on the shores of a United States possession, she was entitled by law, after undergoing such extensive repairs, to United States registry. The opponents, however, claimed that granting this registry to the vessel would violate the spirit of the law, and would prove a hardship to their (the S. F.-H. S. S. Co.) company, and to other lines that had in service American-built vessels which cost anywhere from $400,000 to $500,000. The new vessel is named the *Brooklyn*.

Marine Review and Marine Record.—Under date of August 14 the first number of the consolidated papers, *Marine Review and Marine Record*, appears. It is in improved form, published by the Marine Review Publishing Company, Cleveland, O.

Distilling Ship Edgewater.

A very interesting distilling plant was recently installed on the steamer *Edgewater* by the James Reilly Repair and Supply Company, of New York. The vessel was bought by the British Government and the work was under the supervision of Mr. W. Blackburn Smith, consulting engineer, of this city, as the special agent for the Government. The Edgewater was formerly a steam lighter, built at Rondout, New York; is of white oak, and is 96 feet long over all, 25 feet beam, and 7 feet 6 inches draft. The propelling machinery consists of a compound engine with cylinders 16 and 27 inches in diameter by 16 inches stroke, driving a 6 feet 6 inch propeller. There is a Wheeler surface condenser, an independent centrifugal circulating pump, and a duplex air pump. The single elliptical Scotch boiler is 9 feet long, 8 feet 6 inches wide, 11 feet high, fitted with two corrugated furnaces 42 inches in diameter, and has a heating surface of 38 square feet. The evaporator and distilling plant were placed on the forward open deck, with the exception of the two circulating pumps which were placed in the hold. This forward deck was afterward housed in, and the sides were carried to the after end of the original deck house. As seen in the illustration, the bow is protected by a breakwater.



DECK PLAN OF DISTILLING SHIP EDGEWATER.

The plant consists of six steel-shell evaporators, each 5 feet in diameter by 8 feet in height; three copper-shell distillers, each 2 feet 3 inches in diameter by 4 feet 6 inches in height; one steel-shell feed-water heater, 2 feet 6 inches diameter by 5 feet 6 inches high; two duplex brass fitted feed pumps for feeding salt water to evaporators; two duplex brass-fitted circulating pumps for circulating sea water through the distillers, and one brass-fitted tank pump for pumping distilled water from tank in hold of vessel to reservoirs on shore. The cut above gives the general plan of plant.

The evaporators work in two separate and distinct triple effect plants, one on the port and the other on the starboard side, but are so cross-connected that one or more shells can be cut out for cleaning without interfering with the working of the remaining shells. Steam at 100 pounds pressure is supplied to the evaporators and pumps, as well as to the main engine, by the above-mentioned boiler.

One feed and one circulating pump only are required to operate the entire plant, the extra pumps being for emergency. The evaporators are of the Quiggins type, as manufactured by the James Reilly Repair and Supply Company, and are fitted with large rectangular doors to facilitate the removal of coils for cleaning. The feed-water heater is of the marine type, similar in design to those installed in the feed lines of a large number of steamships and yachts by this company.

This portable distilling plant was built to supply fresh water to the Boer prisoners who were confined on several of the small islands in the Bermudas. The vessel was to evaporate sea water, and steam from island to island and deliver fresh water from the storage tanks in the hold to the receiving tanks on shore. She can proceed from port to port under her own steam at a speed of four knots, and at the same time run the evaporators. When the evaporating plant is not running the speed is ten knots.

The plant was designed for an average capacity of 25,000 gallons in 24 hours while sailing at a four-knot speed.

The official test was made under the direct supervision of Commander F. S. Leslie, commanding the Royal Engineers in Bermuda, and the following results were obtained:

Capacity in 24 hours, 50,240 gallons.
Boiler pressure, average, 87 1-2 lbs.
Pressure in shells, H. P., 26 lbs.
Pressure in shells, I. P., 13 lbs.
Pressure in shells, L. P., 1 lb.
Temperature, Fah., salt feed, 200 deg.
Temperature, Fah., circulating water, 67 deg.
Temperature, Fah., fresh water discharge, 95 deg.
Temperature, Fah., feed suction, 90 deg.
Discharge, 90 deg.

The *Edgewater* is equipped with lifeboats and other appliances necessary to pass inspection.

DISTILLING SHIP EDGEWATER, BUILT FOR THE BRITISH GOVERNMENT SERVICE IN THE BERMUDAS.

This plant was installed with great promptness, as only four weeks elapsed from the time the order was placed until the boat was completed and ready for sea.

An Old Ship.—What is stated to be the oldest ship in the world was recently sold in the Canary Islands and broken up. It is the Italian vessel *Anita,* registered at the wharfs of Genoa. The *Anita,* which resembles Christopher Columbus' ship, the *Santa Maria,* is stated to have been built in Genoa in 1584, and, up to within a few weeks, has been in commission on ocean voyages. She was exceedingly heavily built and during her long career weathered countless storms and tornadoes in all parts of the world.

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IT is only a truism to say that no topic which presents itself for the attention of the designer, builder, and operator of ships and shipping is of more importance than that of safety to human life. It must, however, be admitted that it has thus far not received the attention, and is not receiving the attention, which is so clearly its due. Its importance is only too often drawn to our attention by catastrophes more or less serious, but the sum total of our efforts, in the past decade for instance, has produced but slight advance, and it seems not far wrong to assert that, in comparison with advances in technical and engineering matters, improvements looking to increased safety are sadly lagging behind.

We should perhaps define here what we mean by safety at sea. We do not mean absolute safety from natural disturbances. That is obtainable nowhere. The most that could be asked is that the risk from such disturbances be reduced to what it would be on land in the quiet and regular routine of a settled domicile. This is perhaps asking too much, but nevertheless it may well be taken by those interested in this question as a goal toward which to work, and because its complete attainment is perhaps unlikely is no reason for lack of effort in this direction.

Among the reasons for the relative neglect of provision for safety we may note, first, the exceedingly difficult nature of the problem. There is no doubt that the adequate safeguarding of life at sea is one of most tremendous difficulty. Nature has her fits of passion difficult to foretell, impossible to forestall, and in such the provision which we may have deemed all-sufficient is ruthlessly swept aside. The problem is one which has enlisted in modern times a vast amount of effort, but with indifferent results.

A further and still stronger reason is found in the fact that, like all other good things, increased safety at sea can only be purchased at the expense of other features. A ship, like all other engineering structures, is a compromise between mutually opposing considerations. No one feature can be present in especial prominence except at the sacrifice of others which are to be desired. Thus it would be relatively easy to construct a ship in which all other features would be sacrificed to safety at sea, and in which a long step toward the attainment of ideal conditions might be made. Such a ship, however, would be slow in speed, limited in carrying capacity both for passengers and cargo, and the necessary price for either would be so high that from a commercial standpoint the venture would be a dismal failure.

This brings us to the most important of the reasons why ships are not safer than they are or why more attention and prominence are not given to this feature in modern marine practice. It is simply and solely because the public does not demand it. In accordance with social and economic laws these matters adjust themselves strictly in accordance with the demands of the public; those whose servants the ship builders and ship owners really are. The demands of the carrying trade both for passengers and for freight, both as regards price to be paid and speed of transit, are at the present time such as to preclude the highest expression of the feature of safety. Both the modern traveler and the modern shipper prefer some increased risk with high speed and lower price rather than greater safety with lack of speed and higher price.

These remarks are in particular true with regard to means of safety which require a large expense in weight, space occupied, initial cost, cost of maintenance, etc. It does not follow, however, that because the introduction of certain

features will necessarily lead to some compromise, and to an undesirable change in valuable features of the ship, that we are doing the very best we can with the weight, space, cost, etc., which we are ready to assign to considerations of safety. Here is the opportunity for the inventor or the student of improvements in this direction. We may be sure that the existing combination of features which prevails in modern practice is by no means the best, and that, without any material loss in other valuable features, some other combination may be found which shall furnish a notable improvement over present conditions. This is the problem which is now attracting much attention, but thus far with no very notable results.

Here again public sentiment may do much in prompting such study by showing to inventors that the time is ripe for their best efforts, and to ship owners and designers that special attention paid to such features will prove a strong advantage in the race with competitors. To state again our main proposition: ship builders and operators are the servants of the public, and, within the limits of modern engineering practice, the public can have what it wishes by speaking for it and by accepting the consequent conditions. In the meantime there is no doubt but that the public would like increased safety, but without loss of other features; that is, without accepting what would naturally be the consequent conditions. Doubtless improvements can be made along these lines and under these limitations, and these are the problems which will certainly repay the most persistent and careful study on the part of all who are concerned with serving the public in this manner.

GASOLINE, like many other natural products, is a good friend and servant, but a merciless and destructive enemy. Its attitude, whether that of a servant and friend or enemy, depends solely on the way in which it is used. Intelligent use insures the former, ignorance and carelessness the latter. Intelligent use demands a good understanding of the physical properties and peculiarities of gasoline, and to this end Mr. E. W. Roberts has prepared for our readers the article which we publish elsewhere in this issue. It is there shown that gasoline has been often blamed unjustly and feared unnecessarily, while at the same time just grounds for caution are clearly stated. We would commend a careful perusal of this article to all who are interested in the use of gasoline in any manner whatever.

THE present situation as regards naval ordnance and armor is one of especial interest. The performance of the Army 12-inch rifle firing a shell loaded with the new high-power explosive and fitted with the new time fuse, in piercing 12-inch Krupp armor, has established a new record for penetrative and destructive power, and for the moment scores a point for the gun in the ceaseless struggle between guns and armor. The success which the Army ordnance officials have thus attained in penetrating modern armor with projectiles loaded with high-power explosive was first announced in a paper read at last fall's meeting of the Society of Naval Architects and Marine Engineers, and naturally awakened the keenest interest among all those concerned with naval design and construction. Later developments and improvements have amply confirmed these results, and penetrations have been realized indicating the possibility of carrying a charge of high-power explosive through even 14 inches of Krupp-process armor. This means the possibility of piercing with an explosive shell the armor belts of our heaviest battleships, and thus of setting at naught the best efforts of the naval designer in the protection of the vital features of his ship.

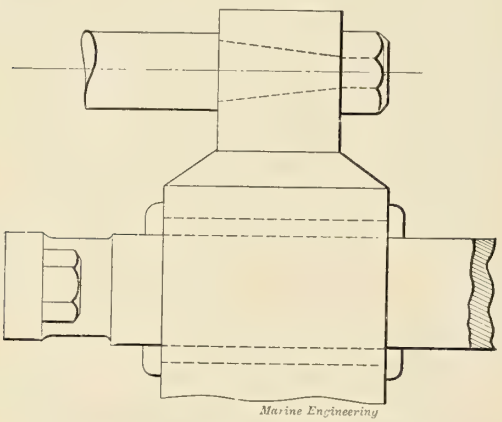
It is small wonder that naval designers feel that the immediate future of the armor question is involved in considerable uncertainty. In the meantime, however, a note of interest has been made public regarding a process intended to offset, at least in some measure, this latest advance of the gun. We refer to a new process for face-hardening armor proposed by Lieut. Cleland Davis, U. S. N., and which is now under investigation at the ordnance works of the Bethlehem Steel Company. The method, in outline, consists in subjecting the face of the plate to the influence of electric arcs of enormous power, and passing between carbon terminals of peculiar form and disposition. Under these circumstances it is found that carbon is carried into the face of the plate to a depth depending on the time employed, but which in any case is far less than for similar surface carbonization with the Harvey or Krupp processes. Following this subjection to the influence of the electric arc, it is found that the plate is susceptible to face hardening to a degree even beyond that attained by the Krupp process. The chief trouble thus far has been with the question of uniformity, but the results have been so promising as to give strong grounds for the hope that in this way a decided advance may be made over the results reached with the Krupp process.

MISHAPS AND REPAIRS.

Derangement of Reversing Gear.

Editor MARINE ENGINEERING:

At the recent dock trial of the new S. S. *Mackinaw* a somewhat peculiar derangement occurred to the reversing gear which for a time baffled the efforts of a number of competent engineers to locate. The main engine is of the ordinary vertical triple-expansion type, having cylinders 17, 27, and 43 inches in diameter, respectively, by 24 inches stroke. The high-pressure valve is of the piston type, 9 inches in diameter, and the intermediate and low-pressure valves are of the ordinary double-ported slide type, and, consequently, rather difficult to work owing to the great amount of friction. The reversing engine is 9 inches in diameter by 11 inches stroke, and apparently amply large to reverse the engine under any and all circumstances. Unlike the ordinary arrangements, this reversing engine was bolted to the back of the intermediate cylinder, and worked vertically on a reversing arm keyed to the reversing shaft, which works in brackets secured to the short back columns of the engine.



CROSSHEAD GUIDE OF REVERSING ENGINE.

Steam was put on the engine in the early morning, and the reversing engine and gear worked in an entirely satisfactory manner. As the engine was run continuously for ten hours, there was no occasion for using the reversing engine until the end of the dock trial. It was then found that the reversing engine absolutely refused to move. The working lever and the valve of the reversing engine worked all right, but the piston would not budge. It was suggested by some one that the valve had slipped on its stem; the valve-chest cover was removed and the valve was found to be in place, and it was also proven to work very easily on its seat. Another wiseacre diagnosed the difficulty as coming from a lack of lubrication of the slide valves. Oil was therefore pumped into both the intermediate and low-pressure valve chests; the engine was run ahead for a few moments until the valve seats could be well lubricated, but still the reversing engine refused to be moved. Another wise man suggested that the packing ring of the reversing engine piston was fitted too tight and had jammed, but this was found not to be the real cause. Although there were a dozen experienced men around the engine room, none could seem to suggest a remedy. On the following day, after the engine had cooled down, a systematic search was made to locate the trouble. A block and fall was hitched to the links, but the united efforts of three men did not cause them to move. It was finally decided to strip the entire reversing gear. Before much had been done in this direction the real cause was detected. The reversing engine crosshead had simply nipped on the crosshead guide. This guide was arranged as shown in the sketch.

The guide was of the ordinary bar type, of forged steel. The crosshead was also of forged steel, but the working surfaces were composed of brass gibs fitted as shown. It was seen at once that the gibs had been made a neat fit in the shop, and, upon becoming heated, the difference in expansion had simply caused them to nip on the bar guide. As the reversing engine was bolted to the intermediate cylinder, the guide and crosshead did not become heated up when the main engine was first started. After running all day everything about the reversing engine was, of course, thoroughly heated up and, as a result, the foregoing derangement took place. The brass gibs were subsequently scraped down, and no trouble has been experienced with the reversing gear since. C. A. MCARTHUR.

Engine Breakdown on U. S. S. Manila.

Editor MARINE ENGINEERING:

I send you herewith an account of the breakdown of the compound engine of the U. S. S. *Manila,* which occurred on a recent voyage from Honolulu to Bremerton, Wash., while I was chief engineer. At the time of the accident we were approximately 1,200 miles from the former place, 1,300 miles from the latter, and 1,100 miles from San Francisco, dead to leeward.

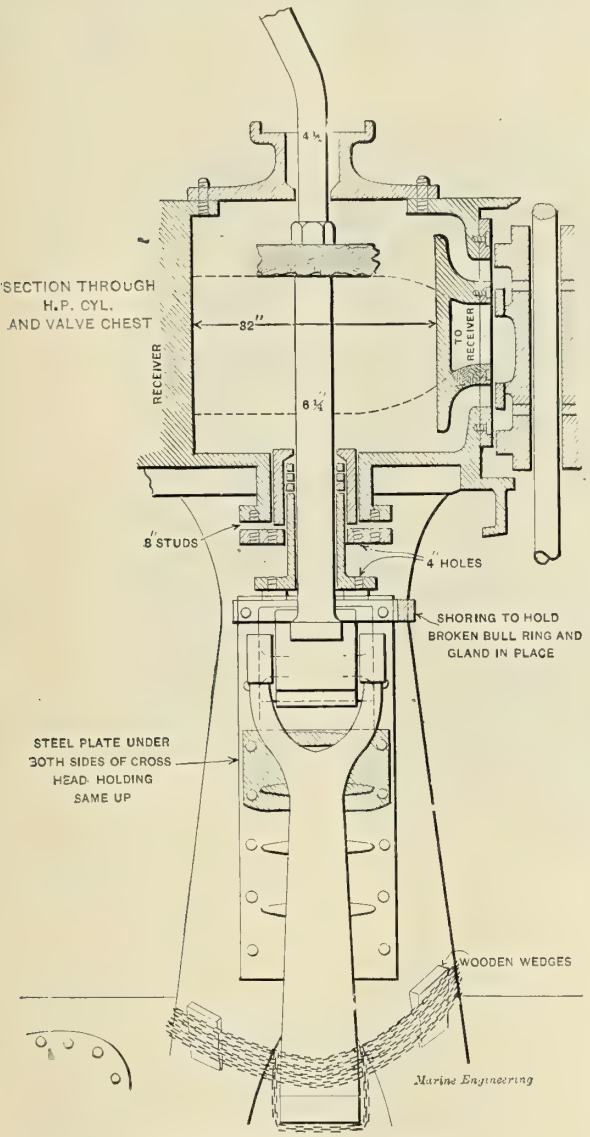
The *Manila* was built in Scotland in about 1881. She was used by the Spanish navy as an army transport until her capture by Admiral Dewey in the battle of Manila in 1898. Since that time she has been used by our navy as a cruiser and latterly as the station ship at Cavite. She is about 1,600 tons displacement, and has one compound engine with cylinders 32 and 60 1-2 inches diameter by 39 inches stroke, which drive a four-bladed screw 13 by 18-foot pitch.

The air pump, circulating pump, and main feed and bilge pumps work off a beam connected with links to L. P. crosshead. The H. P. delivery valve is a single-ported D-slide with a Meyer expansion valve working on its back; the L. P. is a double-ported D-slide. The valve motion consists of Stephenson double-bar links, controlled by a rocker shaft and worked by a continuous motion combination hand and steam reversing engine. Backing and go-ahead eccentrics are secured by set screws and keys to the crank shaft, and the expansion valve is worked from a crank on a face plate bolted to the end of the shaft. The condenser forms part of the back housings, and the front columns are hollow for use as oil tanks. Jacking gear consists of a worm and wheel mechanism driven by a rope belt from flywheel of ballast pump.

The engine works at 65 to 75 pounds steam pressure and makes 60 revolutions per minute, develops about 750 I. H. P., and propels the ship through smooth water

at about 9 knots per hour on 15 to 16 tons of coal, 7 gallons of lubricating and lighting, and a half-gallon of cylinder oil per day. The H. P. and L. P. distributing valves have small balance pistons. The H. P. crank leads L. P. by 90 degrees.

At 2.42 P.M., June 1, 1902, while running at 58 turns, the H. P. piston broke without warning. The men on watch heard a clack resembling water in the cylinder, followed immediately by a crash caused by the breaking



BREAK AND REPAIRS OF H. P. PISTON.

piston. There was a shower of débris from the bottom of the H. P. cylinder, and much live steam escaped into the engine room through the rupture; fortunately no one was injured.

The H. P. cylinder and valve-chest covers were taken off, and the links, eccentric rods and straps, and crank-pin brasses stripped from the engine; the crosshead was shored at the top, and the connecting rod was lashed with chain to the back column. The following damage was found to have occurred: H. P. piston broken into fragments; tail rod bent in two places, remaining about 4 inches out of line; cylinder liner cracked on after side from the lower edge diagonally upward about 18 inches; six of the eight studs holding stuffing box to bottom of cylinder broken squarely off, and the stuffing box broken at the fillet joining the barrel to the flange; crack in go-ahead crosshead slipper, and a bad break in the false valve face and wall between lower steam port and receiver. The piston, which was 21 years old, was of cast iron, flat and hollow, with four cells.

After a careful inspection of the broken parts the accident was accounted for in the following manner: A small piece of the lower wall of the piston, containing part of the threading for a core-hole plug, and one core-hole plug were found in the receiver. The fragment of the piston had two pronounced sand holes and about 2 inches of bad metal along two of its fractured surfaces, and the piston giving way along these lines allowed the core-hole plug to drop while it was making an up-stroke. On the next down-stroke the plug was swept into the exhaust port and met the lower edge of the port of the valve, which was then traveling upward, and wrecked the valve face; when the piston reached the end of this down-stroke it broke into pieces, leaving a hub about 15 inches in diameter on the rod; on the up-stroke the tail rod bent in the first place, and on the next down-stroke the hub caught the wreckage in the bottom of the cylinder between its lower surface and the stuffing box, breaking the latter and precipitating part of the broken piston, some of the follower bolts and piston springs, and fragments of the stuffing-box flange into the engine room.

The valves were removed from the H. P. valve chest, and the remains of the stuffing box and its gland blocked into the bottom of the cylinder against the crosshead, which was held up by steel plates bolted to the slides on either side; melted babbitt was then poured around the piston rod and calked and the cylinder cover replaced. The tail rod was so badly out of line, however, that it was necessary to spring it with differential purchases before the cover would go on. The stuffing box in the cover was then filled with melted babbitt. In this manner the H. P. cylinder was cut out, and steam passed directly from the high-pressure valve chest through the receiver to the L. P. delivery valve.

From 1.30 to 8 P.M. on the second day we tried to start the low-pressure engine, but were unable to get it over the centers. It was noticed that it bound most on the quarters, so the beam was stripped from the crosshead and the air pump guttered, the idea being to run the L. P. engine with high-pressure steam and exhaust into the atmosphere through the air-pump relief line. Investigation showed that there was too much cushioning in the L. P. cylinder, and it was decided to set the go-ahead eccentric back in order to do away with leads. The setting of the valve was equalized by removing liners from under the heel of the eccentric rod, and the angular advance of the eccentric was reduced from approximately 44 degrees to about 13 degrees. It was wanted to reduce the lead to about 4 degrees and allow steam to follow the piston on both ends practically its whole travel; this, however, would have brought the set screw just at the edge of the keyway in the shaft, and the eccentric was moved ahead so as to allow the shoulder of the keyway to take against the

set screw, and the latter was backed by a small piece of wrought iron. The engine then turned slowly and evenly, but it was found that the boilers would not generate steam rapidly enough to run at high pressure, and the sea washing back through the already cramped exhaust line choked the engine. The air pump was reassembled and the beam connected to the low-pressure crosshead and the engine jacked to its top center, so that the impetus caused by its fall would carry it over the bottom center. It was found, however, after one or two failures, extremely dangerous for a man to try to remove the worm from the jacking gear when the L. P. piston was free to move. The crank was therefore shored with the engine on the top center, and steam turned into the lower part of the cylinder through the starting valve in order to form a cushion. A slight vacuum was produced in the condenser by the use of one of the auxiliary pumps and the engine thoroughly cleared of water. At about 2 o'clock in the afternoon, June 4, with everything in readiness, the blocks were knocked away, and, as the force of the drop carried the crank over the bottom center, the throttle was opened wide. The revolution was completed, and the engine ran in this condition for 1,100 miles, making nearly 450,000 revolutions.

It was soon found that no greater pressure than was carried in the receiver when compounding could be used, on account of binding of the low-pressure valve against its face; and as the engine made about 40 turns with 17 pounds absolute in the receiver and 22 inches of vacuum, without straining itself very much, she was allowed to run in this way. The consumption of coal and oil was very slightly less than when compounding at full power. Without further accident we reached San Francisco on the afternoon of June 12.

H. J. ELSON, Ensign U. S. N.

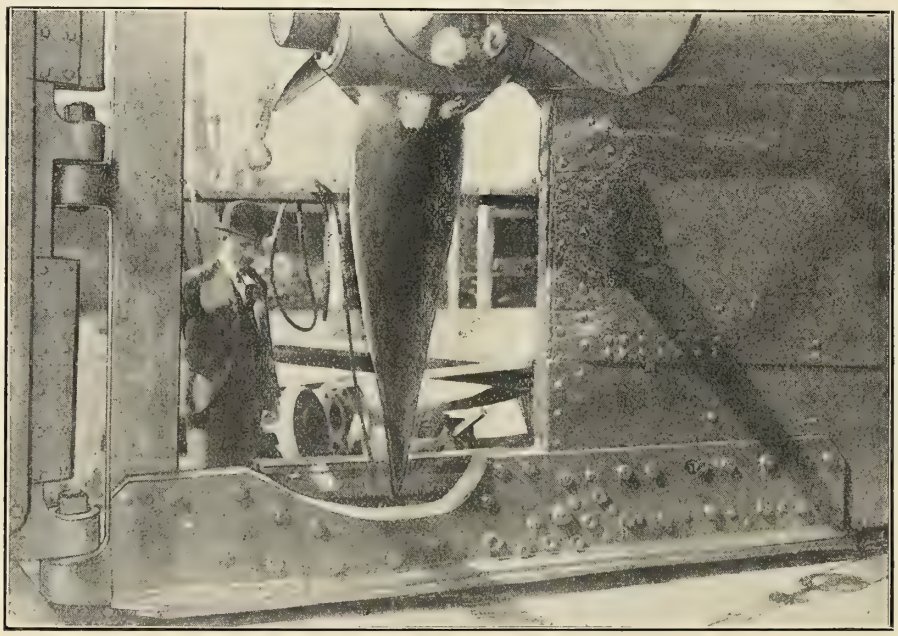
Repairing a Stern Frame.

Editor MARINE ENGINEERING:

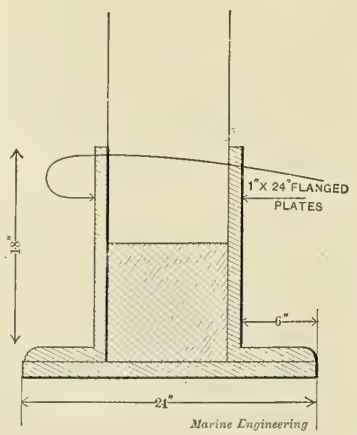
We send you herewith photographs showing repairs recently made by us to the stern-frame forging of the steamship *Oregon*. This vessel has had the misfortune of breaking her stern frame twice in succession; the first time, which occurred last fall, caused the loss of the rudder and rudder post.

As shown in the photograph, the aim in the recent repairs was to make that portion of the frame, namely, the shoe, which has been the source of trouble, amply heavy, with a view of preventing a recurrence of the mishap. The break was located in the shoe, close to the propeller post. Three 1 by 24 inches steel plates were used, as shown in the sketch, the ones on the sides being flanged. All the fastenings are of 1 1-4-inch rivets and 1 1-2 body bound bolts, as shown in the photograph.

M. B. C.



STERN FRAME, BROKEN IN THE SHOE, REPAIRED BY SIDE AND BOTTOM PLATES.



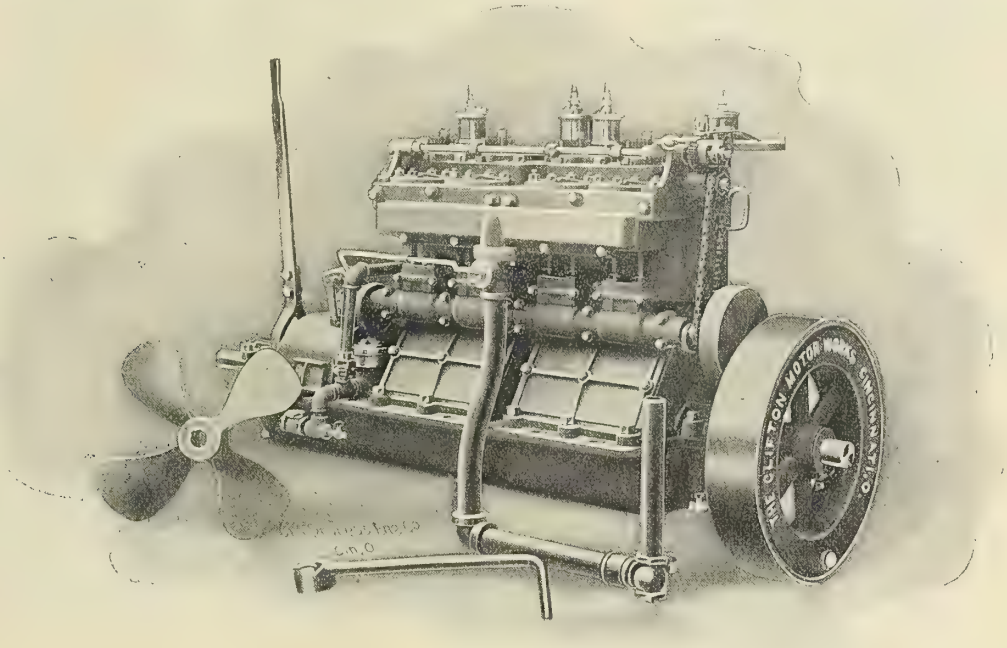
ENGINEERING SPECIALTIES.

Marine Gasoline Engine.

The accompanying engraving illustrates a four-cylinder, 16-horse-power marine engine built by the Clifton Motor Works, 229 East Clifton avenue, Cincinnati, O. From the view it will be seen that this is a compact and a symmetrical piece of machinery. The number of parts has been reduced to as few as possible, and, at the same time, nothing has been sacrificed to simplicity. The engine embodies the latest improvements to be found in this type of gasoline engine, and also several improvements that are distinct innovations.

The bed of the engine is a strong casting, as light as possible consistent with the necessary strength to withstand the strain. The cylinders are cast in pairs, with all the inlet and exhaust openings, water jacket, cores, etc., cast complete. The exhaust is carried between the two cylinders and is taken out on the opposite side from the valves. There is a great advantage in this, as the exhaust is always warm and often quite hot. Being taken out on the opposite side, there are no hot pipes to be encountered in oiling the moving parts of the valve and igniter mechanism. This feature makes the engine more symmetrical in design. The inlet and exhaust valves are both opened mechanically and have large lift. The cam shaft is operated from the main shaft by gears, which are enclosed in a light gear case to keep them clean, and also to prevent injury and deaden the noise. The cam shaft is carried in a cylindrical case bolted to the side of the cylinders. This case also carries the guides for the valve push rods. The cams and push-rod rollers run in oil and are entirely dust-proof.

The igniters are of the make-and-break type, self-contained in separate removable castings. These latter may be taken out by loosening two 3-8 nuts, and replaced with equal facility. Each igniter is operated by a separate cam on the igniter shaft. All are in full view on the tops of the cylinders. The time of the spark may be retarded or advanced by means of a lever, which also operates a switch for cutting out the battery and cutting in the magneto or dynamo as the engine increases its speed. Reversing is accomplished by means of a mechanical reversing gear in the bed of the engine. A governor is also provided which operates a throttle and prevents the engine running away when the propeller is stopped.



FOUR-CYLINDER MARINE GASOLINE ENGINE.

A New Electric Hoist.

Various attempts have been made to design an electric hoist capable of handling heavier loads than come within the range of hand hoists, and not requiring the heavy and expensive supporting structures necessary to carry the large amount of dead weight of ordinary traveling cranes. The hoist shown in the accompanying illustration fulfills these requirements, and is protected by patents owned by the Sprague Electric Company. It is designed to transfer light work rapidly around shipyards, factories, etc., and when supplied with trolley carriage, geared hand cross-travel and bridge-travel motor, to take the place of small traveling cranes.

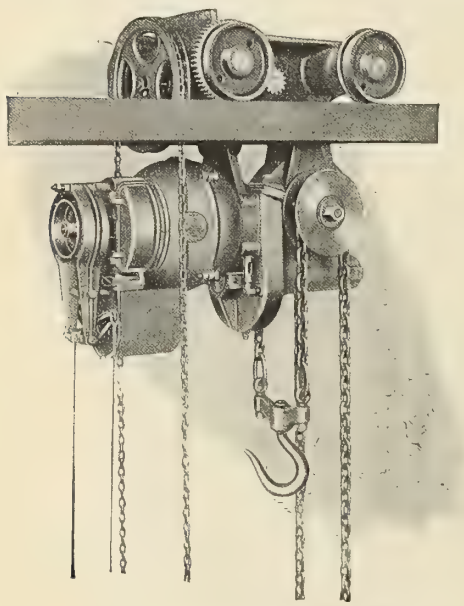
This hoist has many advantages over other equipments, and has a new system of motor control for electric hoists. It has a high efficiency and is much smaller and lighter than any other hoist of like capacity, and is practically indestructible. It consists of few parts, all of which are interchangeable, it is easily adaptable to all types of runways and bridges, and the sizes range in maximum capacities from 1,500 pounds to 10,000 pounds. The smaller sizes can be equipped with a trolley arranged to run on a single rail or I-beam, and,

if so arranged, will take curves of a reasonably small radius.

In designing this apparatus the manufacturer has carefully kept in view the fact that it would be subjected to rough usage. All parts are made of great solidity and of the highest grade of material, while all bearings have been made self-oiling, requiring but trifling attention at long intervals.

All the different movements necessary for a traveling crane, namely, hoisting, lowering, cross travel, and bridge travel, are controlled by a simple pulling of the chains and cords connected to the mechanism, and which can be operated by the ordinary workman. This is a unique feature, to which special attention is called, no special crane operator or cage being necessary.

The motor and hoisting mechanism can be hung from



NEW ELECTRIC TRAVELING HOIST.

a strap if only a hoisting and lowering motion is desired, or they can be attached to a trolley carriage arranged for cross travel, either by pushing the load or by a geared hand traverse motion. A bridge travel is also provided, the controller for which is mounted on the end of the trolley carriage, as shown in cut. This controller is operated by cords, the handles of which are located near the work. The bridge-travel motor itself is mounted in some convenient position on the crane. The bridge-travel motion is reversible, and in practice it is possible to obtain a very short movement in either direction.

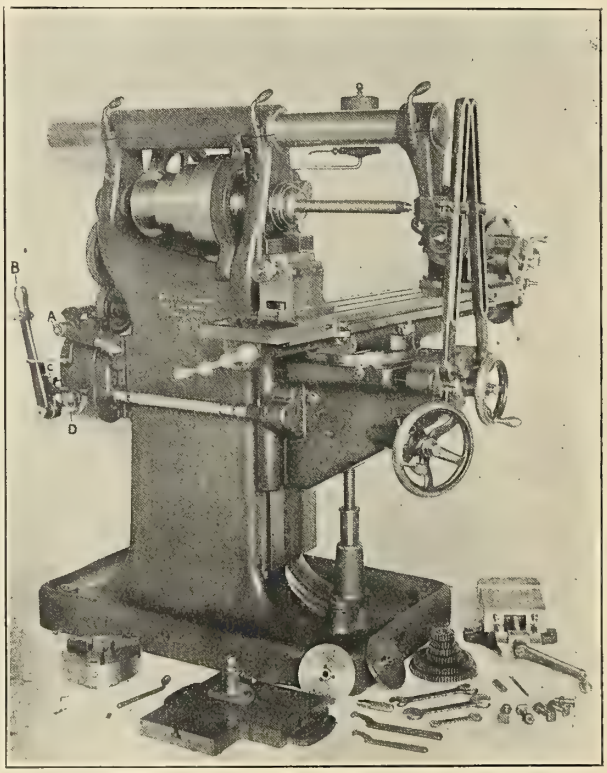
The motors furnished with this equipment are Lundell round-type motors, entirely enclosed, and the hoist can be operated out-of-doors without being affected by the weather. The resistance plates for the bridge-travel controller are of the enclosed type and have a very large overload capacity.

The Sprague Electric Company manufactures and furnishes the complete hoist as shown. A very complete description of the hoist is given in Bulletin No. 20,915, which may be obtained by addressing the manufacturers, 527-531 West 34th street, New York city.

New Model Universal Milling Machines.

The Becker-Brainard Milling Machine Company, of Hyde Park, Mass., has placed upon the market a new line of plain and universal milling machines from new designs and patterns. These machines embody many new features, special attention being given to strength, power, and rigidity in order to meet the demands of modern milling machine practice.

In the universal machines the spindle is connected with the change-feed mechanism by a train of three spur gears, thereby eliminating the usual feed pulleys and belt, giving positive gear drive necessary for heavy and rapid cuts.



NEW UNIVERSAL MILLING MACHINE.

The change-feed mechanism is a novel feature and obviates the loss of time in changing gears, as was formerly the practice in old-style machines. The feed is obtained and driven by the main spindle through a train of three spur gears on the back of the machines, which drive two nests of change-feed gears in the column. By compounding the gears in the upper nest the various changes of feed are secured, giving, with the quick change in the gear case on the outside of the machine, twenty changes of feed for each spindle speed. The changes are made by the simple movement of the levers, bringing them into position as indicated on the index plate, which is at the top of the feed box, and has each feed plainly marked on its face. When the fast feeds are desired, the quick-change lever is thrown into the hole marked "fast."

The power is transmitted from the change-feed mechanism through the telescopic shaft connecting, by gears, the longitudinal, transverse, and vertical feeds, which

are reversed by a lever on the side of the knee within easy reach of the operator. Both transverse and vertical feeds are operated and controlled by a lever located on the side of the knee, which, when central, disconnects both feeds, and when thrown into position for one feed it is impossible to connect the other.

Another important feature is a clutch arrangement enclosed in the hubs of the hand wheels which operate the vertical movement of the knee and cross movement of the carriage. When either the knee or carriage has been set to the required position, the clutch may be instantly disengaged by pressing in the knob on the front of the hand wheel, thereby preventing any accidental change from their fixed position, and also preventing the hand wheels from revolving when the automatic feeds are thrown in.

In designing these machines the greatest care has been taken to secure the highest efficiency, together with accuracy and simplicity. Nevertheless, the parts are so arranged that they are within easy reach of the operator, and of sufficient strength to prevent breakage from undue strain. Metal distribution has been properly proportioned, the base being very solid, thereby absorbing vibration. The arm is a straight steel bar, so that any of the regular attachments can be placed in position without the necessity of its removal.

A Speed-Regulating Device.

A new device along the line on which many inventors are just now approaching the Patent Office—another attempt to solve the problem of greater convenience in speed variation of machinery—is illustrated in the accompanying engravings. The views given illustrate a speed regulator invented by Henry P. White, of Kalamazoo, Mich. The left-hand view is an end elevation and the right hand is a side view, the former having the tight and loose pulleys removed. The inventor has set out with the intention to provide a speed regulator of the cone-pulley type, which may be applied in combination with any desired source of power, and to every class of machine which, in practice, is required to run at various speeds. The design also embodies a construction in which the different portions of the contact surface of the belt travel at the same relative speed upon the surface of each cone, thus avoiding the necessity of a compensating slip at contact surface of the belt.

The natural advantages which the inventor claims for this improved mechanical speed regulator are, first, its range of variations in speed is practically unlimited, as it may be designed to secure any variation which practice will demand; second, its spring-regulated belt tension acts as a safety governor in the operation of machinery; third, its automatic speed indicator makes it possible for the operator to always know at what speed his machine is running; fourth, the easy and practical means it provides for securing any speed intermediate to the two extremes embodied in the design of the machine does not require the operator's hands to come in contact with the belt; fifth, its simplicity of construction, which eliminates every undesirable complication.

The main frame is indicated by *A*, and *B* is the driven cone, mounted upon a shaft which carries the tight and loose pulleys, through which power may be applied to the machine. A corresponding cone, *C*, is mounted upon a shaft located at right angles to the one on which cone *B* is fastened, the pulley *C'* being the medium by which power may be delivered to the machine. A track, *E*, is fastened to the main frame, or is a part of *A*, having a sliding frame, *D*, with a shaft, *I*, and idlers, *H*. *G* is a screw and hand wheel by means of which the sliding frame may be moved along the track, *E*. The dotted lines show the position of the belts when the sliding frame is moved to the opposite end of the track, and the relative places at which the belts are applied will also indicate the proportionate speeds of the cones.

Where the contact surface of the belt travels at the same relative speed on all the pulleys involved there is very little loss from friction, except in the journals of the revolving portions of the machine. The device

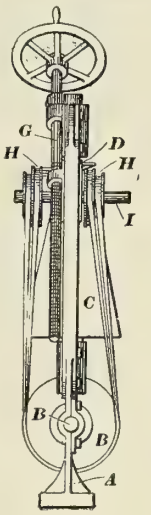


Fig. 1.—End Elevation.

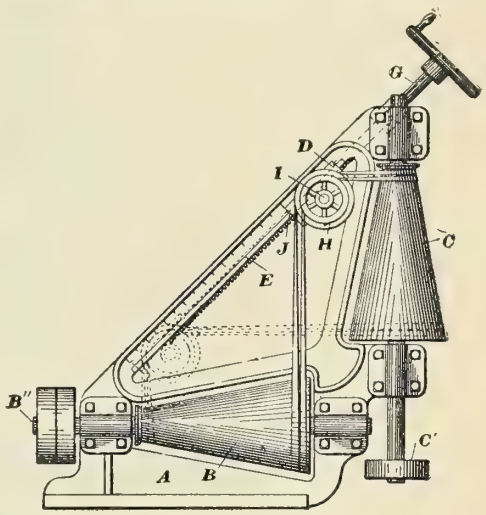


Fig. 2.—Side Elevation.

CONE SPEED REGULATOR.

shown embodies this feature, of such vital import to success in practice. It is made by the New Era Manufacturing Company, of Kalamazoo, Mich.

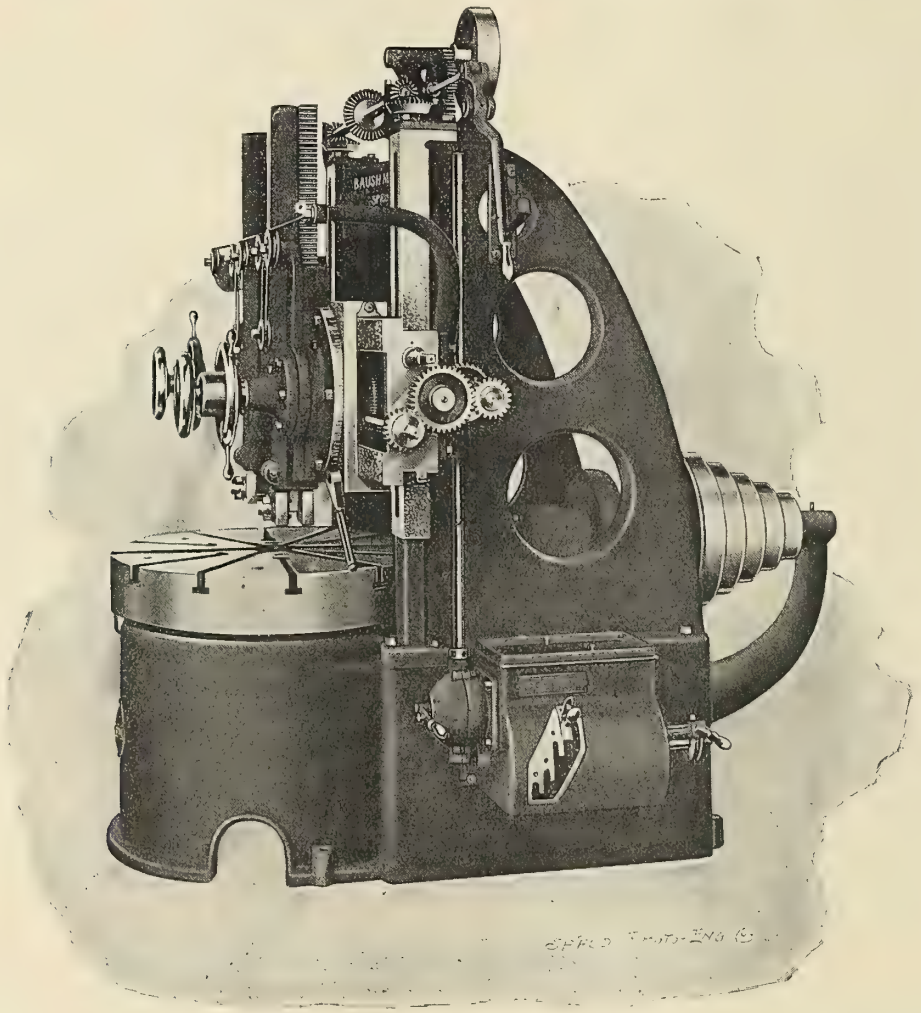
Boring and Turning Mill.

In the accompanying illustration will be seen the 37-inch latest-type turning and boring mill made by the Baush Machine Tool Company, of Springfield, Mass. The care with which the design and construction of this machine have been carried out is evident by inspecting the illustration.

The bed is a solid casting to which the vertical arms are bolted with stud bolts, and to these arms are attached the cross-rails, which are fitted with two heads. The heads can be operated independently of each other by means of a split nut and rack and pinion, and thus be moved back and forth very quickly, which greatly facilitates setting up the different classes of work. There are independent feeds for each head, operated by the Hendey-Haughton device, giving fifteen changes ranging from 1-64 to 9-16 of an inch vertical feed, and from 1-64 to 7-8 inch horizontal per revolution of the table. The change from one speed to another is made almost instantly and without stopping the mill. The cross-rails are raised and lowered by power; the pulley,

as shown in the illustration, is placed in the center at the top and is operated by a lever, thus doing away with the belt from the countershaft. The back gears are arranged so that they can be thrown in and out by means of a lever, without the use of a lock nut.

The table can be removed and replaced by an independent, or an independent and universal chuck. It has an outer bearing with a self-oiling device which guarantees constant lubrication. The main bearing is large and is hung with a hole through the center, allowing the chips to pass through to be removed from the bottom of the mill without clogging. Though the machine is usually built for belt drive, yet it is made so that it can be driven by a motor by removing the cone and bearing and attaching a motor to the bed. The company makes this mill in five sizes, namely, 37, 41, 51, 54, and 61 inches diameter.



A BORING AND TURNING MILL OF THE LATEST TYPE.

The Battleship Maine.—The new battleship *Maine* was dry-docked at the Brooklyn Navy Yard in preparation for the official trial, which took place on August 23. On the builder's trial the figures for speed given out by Messrs. Cramp were 18.29 knots.

New Battleships.—The Navy Department invites bids which are to be opened on October 1 for the new battleship *Louisiana,* one of the two which were recently authorized by Congress. The other battleship, the *Connecticut,* will be built in the New York Navy Yard. These two vessels will be identical in every detail in order that there may be a comparison made between the cost of Government and private construction.

Importing Steel.—Imports of steel billets and pig iron are on the increase, and many vessels have been chartered to bring steel shapes and plates from Great Britain and Europe. Much of this is to be used in completing the ships now under contract. The demand at home is so great for steel that the yards have had to go abroad for their material.

Oil-Fuel Tests.—The Navy Department is conducting a series of tests of oil fuel at the Washington Yard to determine the desirability of using oil as fuel on warships. A water-tube boiler has been mounted similarly as aboard ship and careful determinations are being made of evaporation, etc. It is understood that the various systems of oil burning will in turn be tested.

PRACTICAL POINTS IN SHIPBUILDING.

BY EADS JOHNSON.

Practical ideas and details of ship construction are not to be found under any fixed or standard rules. Methods of construction vary in different yards, as facilities for handling material determine, and still, if two yards were fitted with identical means for erecting and handling the materials which go to make up a ship's structure, it is doubtful if the same methods of construction would be followed in the two cases. Each and every constructor has ideas of his own, and, although vastly different from each other, they bring out the complete ship as though all intermediate steps were the same.

Under the headings to follow it is hoped to give as broad and general methods of construction as possible. They are not, however, intended to be taken as settled or ideal methods, but merely those which have been followed and have been successful.

PREPARATIONS FOR RECEIVING THE FIRST FRAME ON KEEL OF STEEL SHIP.

From the mold loft on scrieve board, the half-breadth at the midship frame or the frame selected to

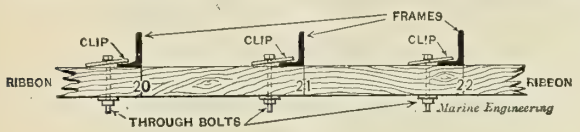


FIG. 1.

erect is obtained, and the height of ribbons and their location on frame are also noted.

The frame spacing is laid off on 4 by 4-inch or 3 by 3-inch rough pine ribbons, and the mark of the heel of the frame is scrieved thereon. At a distance of 1 inch from the point where the toe of the angle intersects the rib a hole is bored in the ribbon so that a 5-8-inch bolt may be run through and a large washer or clip is put on, as shown in Fig. 1, with which the frame is secured when set in place.

Now, after having prepared two or more ribbons in like manner to take frames above the bilge, support them at their respective heights, which are to be had from the loft, as before stated. Other ribbons are set alongside of the keel at the proper height above the ground, supported by shores and tied 'thwartships by light ribbons, so that a crib is formed by the ribbons for the reception of the frame. Ribbons should always be located in way of an outside shell strake, so that they can remain until the inner strakes are up and bolted to the frames. These ribbons are run fore and aft of midship as far as the length of timber will allow, and other lengths are butted to them which extend to the stem and stern. These end ribbons are put up after the middle frames are in place.

Now erect the frame, and, after it has been secured, square a line across the keel and prove with a horning batten or steel wire to make sure of the square. Proving with a horning batten is nothing more than proving a square line with a radius. In Fig. 2, *FF* represents the frame and *KK* the keel. A point *A* on the keel forward of frame and one aft the same distance from frame are located. A batten is used that will reach from *A* to a point *B* located on frame any distance from the keel. Now, to make sure of square, see that the distance from *A* to *B* is the same and equal to the distance from *B* to *C*. Sometimes a steel wire is used instead of batten, in which case the same method is followed.

Now place two straight edges on the outermost ribbon under the bilges, and have these set vertically in a

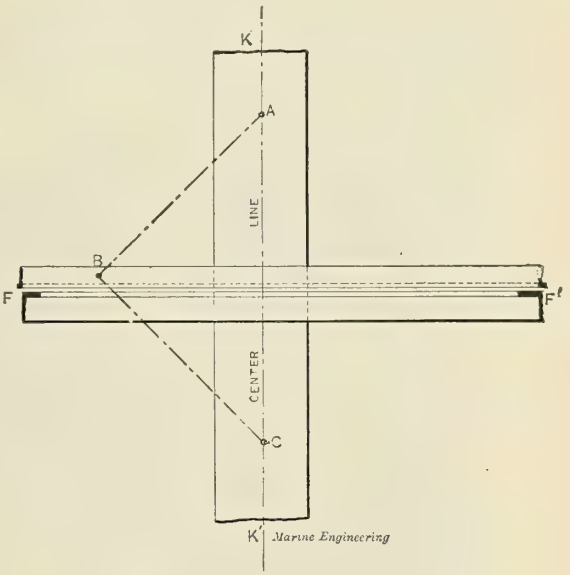


FIG. 2.

plane perpendicular to the keel, then the frame is set in wind with them 'thwartships. This method is shown in Fig. 3, where the straight edges are designated *A* and *B*. Now the frame is made fast to the ribbons, and two or

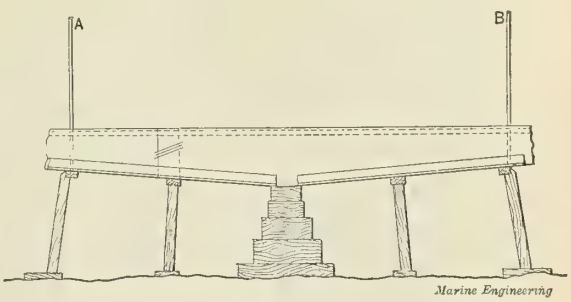


FIG. 3.

three spur shores are put up under each ribbon at an angle of 45 degrees, fastened to the frame by through bolts and to the ground on heavy timbers bedded in earth and staked with long wood screws. These spur shores prevent the frame once set, squared to base line and to the proper declivity, from moving fore or aft. They are usually led aft, but where frames are ex a heavy one spur shore leads forward and may be fastened to the frame at the bilge. Thus having the frame so secured, other frames may be erected fore and aft of this one, and, with the exception of plumbing up and lining after the stem and stern posts are up, no other precaution is necessary to have the ship fairly framed.

SETTING FRAMES.

There are many minor points in setting the frames of a steel ship which may not appear to be of vast importance and which are lost in comparison with larger details, but at the same time they must be carefully carried out and are essential to the proper and true assembling of the ship's structure. We suppose the keel blocks laid and the keel plates on the blocks, with the cradle of ribbons ready prepared with the frames scribed thereon. Suppose the midship frame to have been set and spauled. The frames should then be set in rotation fore and aft of the midship frame, in order that there be no interference, as it is not practical to drop in intermediate frames where the ship has any amount of tumble home, provided, of course, that the frames are bolted securely or riveted on the ground and erected complete.

Where center keelson is continuous, the frames being clipped to the keelson, frames are more easily erected, necessarily being put up in half sections where the above procedure does not apply.

The usual clips are placed on the ribbons to secure the frame in place, and as they are set up the clips secure them in a fore and aft direction to the scribed marks on the ribbons. It is all very well to secure them to the ribbons, provided there is a continuous vertical keel, and the frames may go up in half breadths; but when the frame complete is continuous 'thwartships it should not be secured tightly to the ribbons until it is centered on the keel plate and bolted securely thereon, because if it were bolted to the ribbons tightly, without first having been centered on the keel plate and bolted, drifting might be necessary to fair it up. The corresponding holes of frame and keel and keel plate would be very likely pulled from the

FOREBODY OF THE STEAMER BANES, DAMAGED BY FIRE.

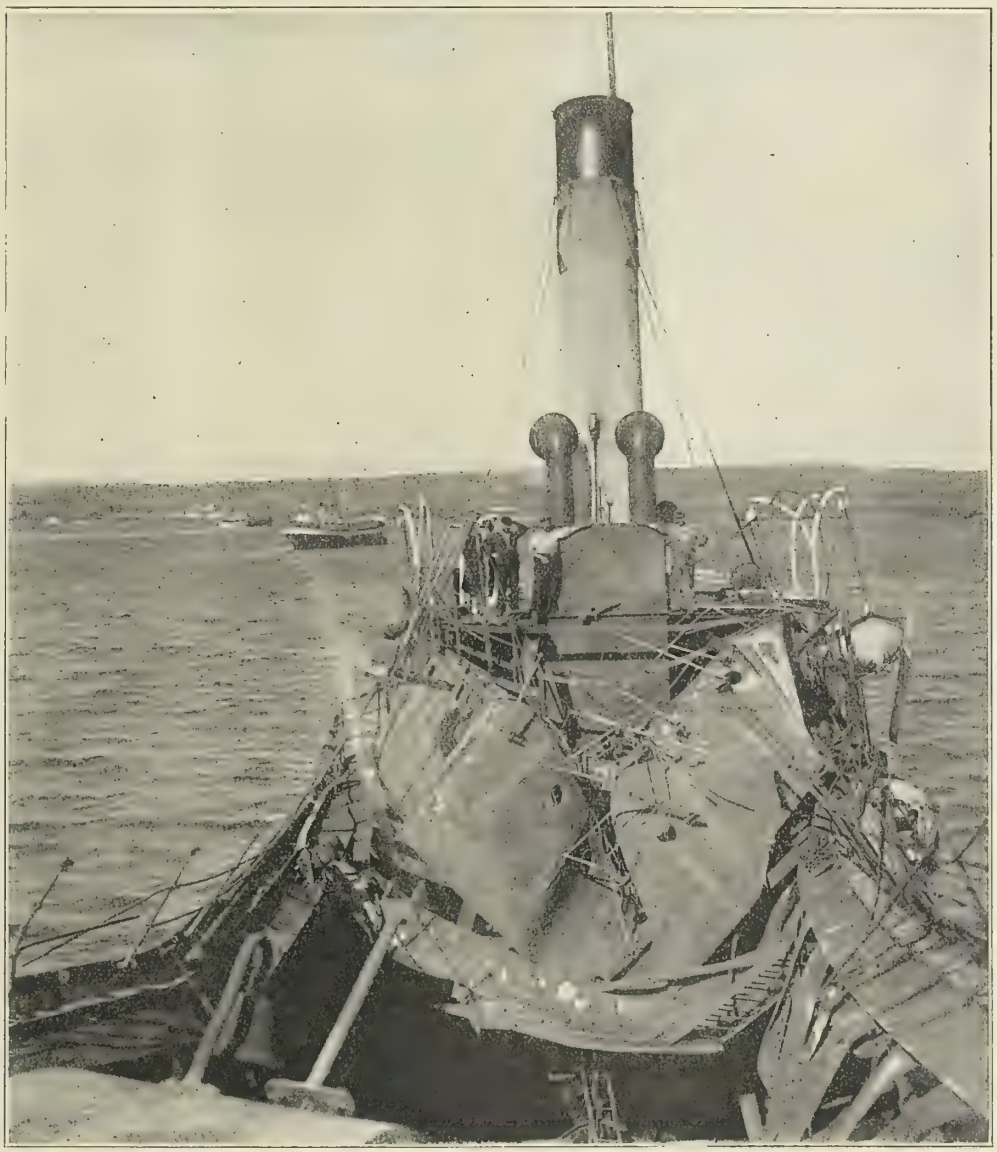
center line and thereby cause unnecessary trouble and expense in lining up afterward. Therefore it is best to have the frame bolted securely to the keel plate and centered before it is secured to the ribbons.

SPAULING.

Should the frames be ready for erection before the beams are ready, the frame is spauled. This is done by using timber not less than 12 by 3 inches in section and long enough to span the frame. The timber is bolted to the frame, port and starboard, about 3 feet 6 inches below the line of the main deck, so that it is held at the correct breadth at that point. This wooden beam is stiffened by using an upright of 6 by 3-inch timber erected at the center and fastened securely to beam and to floor plate, or to the reverse bar on top of floor plate. Thus the frame is held as if it were beamed; and as the wooden beam is held below the line beam, the frame may be beamed later; meanwhile, it may be set and squared as before stated.

Burning of the S. S. Banes.

On a voyage from Mobile, Ala., to Bocas del Toro, Colombia, the steamer *Banes*, loaded with a general cargo, including yellow pine and fifteen carboys of naphtha, caught fire. The fire broke out in the forward hold on the morning of the 29th of December last, when the vessel was 120 miles from the western coast of Cuba; and although it burned for twenty-four hours,



THE STEAMER BANES, DAMAGED BY FIRE, LOOKING AFT.

Capt. Peter Tronstad succeeded in bringing the *Banes* under her own steam into Havana harbor. There a contract was entered into by the owners for repairing the vessel at that port, but, owing to insufficient facilities, it had to be given up.

Messrs. Daniel Bacon and S. E. Turner, of New York, then bought the *Banes* and had her upper works planked up, and in this shape she steamed to New York. The contract for repairs to be completed in forty days was recently awarded to the Perth Amboy Shipbuilding and Engineering Company, Perth Amboy, N. J.

The views of the wrecked steamer, one taken from the bow looking aft and the other from the bridge looking forward, show how completely the upper construction and top sides were damaged, the forebody of the ship above the water line, where the fire was the most intense, having completely collapsed. The repairing will necessitate the following work: The renewal of all frames and reverse frames in the forward hold; all the deck beams, deck plating, and shell plating above the water line; also new collision and fire-room bulkheads and keelsons in the hold. Twenty-five feet of the forward deck house is also to be rebuilt; two decks are to be planked over; the windlass and deck engine are to be repaired, new steering engine fitted, and the ventilators and deck fittings renewed.

QUERIES AND ANSWERS.

Q. 100.—Will you please give, through your magazine, the rules for finding the point of cut-off with the initial and terminal pressure given? Also the rules for finding the terminal pressure when the initial pressure and point of cut-off are given. I have several different rules, but none of them give the same answer. J. P. S.

A.—It is impossible to give you any exact rule for determining the terminal pressure from the point of cut-off, simply because the real expansion ratio is not given by the point of cut-off, and, furthermore, the drop in pressure for a known expansion ratio depends to some extent on the quality of the steam and other conditions. The point of cut-off does not indicate the real expansion ratio, simply because the effect of the clearance is not included. The steam in the clearance space counts, of course, as part of the total volume present, and it is the change in this total volume which fixes the expansion ratio.

To determine the real expansion ratio from the cut-off and clearance the following rule may be used:

Add the clearance per cent. to 100 and also to the cut-off per cent., and divide the former by the latter. The quotient will be the true ratio, including clearance. Thus with a cut-off at 60 per cent. and 12 per cent. clearance the apparent expansion ratio would be $100 \div 60 = 1.66$, while the true ratio will be $(100 + 12) \div (60 + 12)$ or $112 \div 72 = 1.55$.

Having found the true expansion ratio, the final pressure can be found approximately by dividing the initial pressure by this ratio.

Thus, if the pressure at cut-off in the example was 155 pounds the terminal would be nearly $155 \div 1.55 = 100$ pounds. Actually the terminal pressure will be a little less than this, the amount of clearance depending on the special conditions of the case, but usually not exceeding 10 per cent.

By working the same rule backward the point of cut-off may be found approximately for a given initial and terminal pressure. Thus:

Divide the initial by the terminal pressure, and thus find the expansion ratio. Then add the clearance per cent. to 100 and divide by this expansion ratio. Then from the quotient subtract the clearance per cent., and the remainder will be the true cut-off per cent. Thus, for example, with the problem above, having given 155 as the initial and 100 as the terminal pressure, we divide one into the other and find 1.55. Then, assuming 12 per cent. clearance, we divide 112 by 1.55, finding 72. From this we subtract 12, leaving 60 per cent. as the point of cut-off. The true point of cut-off will usually be a little later than the point thus given, due to the fact that the drop in pressure is not in exactly the same ratio as the increase in volume. To take account of this by estimate the terminal pressure may be increased slightly, say 10 per cent. of its value, and then proceed as before.

If you are familiar with the use of logarithms, the following rule will take account of the expansion law as found on the average, and will give very nearly accurate results.

Rule: (1) Add the clearance per cent. to 100 and also to the cut-off per cent., and divide the former of these results by the latter.

(2) Find the logarithm of this quotient and multiply it by 1.15.

(3) Find the number corresponding to this logarithm and divide it into the initial pressure. The quotient will be the terminal pressure.

Or to work the other way:

Rule: (1) Divide the initial into the terminal pressure and find the logarithm of the quotient.

(2) Divide the logarithm by 1.15 and find the corresponding number.

(3) Then add the clearance per cent. to 100 and divide by this number.

(4) From the quotient subtract the clearance per cent., and the remainder will be the cut-off per cent.

It must be remembered that this rule and process gives simply the relation between the cut-off, clearance, initial pressure, and terminal pressure in one cylinder. The total expansion in a compound or triple-expansion engine is quite a different matter, and involves the volumes of the cylinders as well as the point of cut-off in the high pressure.

Q. 101.—Suppose that the L. P. crank pin of a compound engine (marine pattern) broke, or, in other words, cracked so that it would not be safe to run in that condition, what could be done to bring the ship into port? The engine having the air and feed pumps worked off the L. P. Please let me know the best, safest, and quickest way to repair the same at sea. Hoping that you will oblige and give me a remedy, I remain, J. E. B.

A.—We assume you mean that the break in the crank pin is too serious to repair in itself, and that it is a question, therefore, of making the best of your way to port without attempting to repair the broken part. In a case like this the quickest repair is to break the H. P. exhaust connection, and improvise as well as possible an exhaust lead to the deck or to the funnel. The air pump should also be disconnected. The H. P. cylinder may then be worked non-condensing, and will, under these conditions, develop something over one-half the full power of the engine. Of course the engine may not handle very well, and there may be some trouble if there is much backing and filling to be done, but for a quick repair it is the best that can be done. If more time is available the L. P. valve may be removed and the ports blocked off, thus allowing steam to exhaust from the H. P. through to the condenser. The L. P. piston rod may also be disconnected from the crosshead and the piston and rod shored up to the top of the stroke. This will leave the L. P. crosshead and air-pump levers connected to run as usual, and with this arrangement the H. P. cylinder may be operated condensing, with a corresponding increase in power. If suitable piping were at hand it might be more convenient to make up a lead direct from the exhaust side of the H. P. cylinder to the condenser. In any case the L. P. crosshead must be operated in order to drive the feed pumps.

Q. 102.—Thinking of building a 50-horse-power triple-expansion engine, could you give me the diameter of each cylinder? I want the stroke to be 2 inches longer than the bore of the cylinder and the steam pressure to be 200 pounds to the square inch. J. A. W.

A.—Taking a total expansion ratio of 11, we find with an initial pressure of 200 pounds a reduced mean effective pressure of about 37.7 pounds. With a piston speed of 400 feet per minute this would call for cylinder diameters of 4 1-2, 7 1-4, 11 3-4, and with a length of stroke 9 1-4, which is 2 inches greater than the intermediate, you would have 260 revolutions per minute. This would give you a fairly well proportioned engine of moderate piston speed and revolutions, and such as might very probably serve your purpose. The proportions would be improved somewhat, however, by decreasing the stroke and increasing the revolutions. Thus, with a stroke of 8 inches, the engine would be in better proportion and the revolutions would then become 300. This is not extreme at all, and such an engine would well represent the proportions and conditions of modern practice.

COMMUNICATION.

Spacing of Boiler Stays.

Editor MARINE ENGINEERING:

A number of cases have come under my notice lately which show a great difference in the method of staying the segment of boiler heads above the tubes, and I would like to get your opinion as to which you consider the proper spacing of same.

For instance, on page 20 of the British Columbia Laws, just issued, for governing construction of steam boilers, we have the following:

"When the head is flanged and riveted to the shell, a portion of it becomes stiff enough to carry the boiler pressure without depending on the braces. The distance that thus becomes self-supporting may be determined by the following formula:

$$D = \frac{4.484 \times T}{10 \times B} + .5$$

when T = Thickness of head in inches.
B = Safe working pressure of boiler.
D = Distance in inches.

"When the boiler head has several rows of tubes expanded into it, a portion of the head beyond the tube becomes stiff enough to be self-supporting, and it is safe to assume this as two-thirds of the distance determined by the preceding formula."

This I found to require more stays than I have been accustomed to put in. In fact, on a 56-inch boiler which I figured with 7-16-inch heads, suitable for 130 pounds working pressure, the distance D only makes out to be 2 inches, which would require the outer row of stays to be exceptionally large.

Also in a work published by Prof. Wm. M. Barr we have the following discussion of the subject:

"In addition to this, the influence of the flange extends inward, and no braces need be located within 4 inches of the flange radius for pressures less than 100 pounds per square inch; . . . and unless in the case of curved intersections and odd spaces which require a brace, the regular line of braces for pressure not exceeding the above need not be closer than 3 inches.

"The holding power of the tubes imparts sufficient stiffness to the boiler heads as not to require braces nearer than 4 inches, so that in all ordinary calculations the area to be supported would be represented by a segment of a circle of 6 inches less radius than the boiler head, and its base line 4 inches above the tubes."

These, however, I consider not distinct enough for practical purposes. In laying out boilers according to the marine laws of Canada, I have always been accustomed to assume that the flange on the head acts just the same as the stay bolt, and will carry quite safely half way down the first row of stays, they being placed as far from the flange as the plate formula would allow.

If you have any further information or any other authority to whom you could refer me, I would be very glad to hear from you.

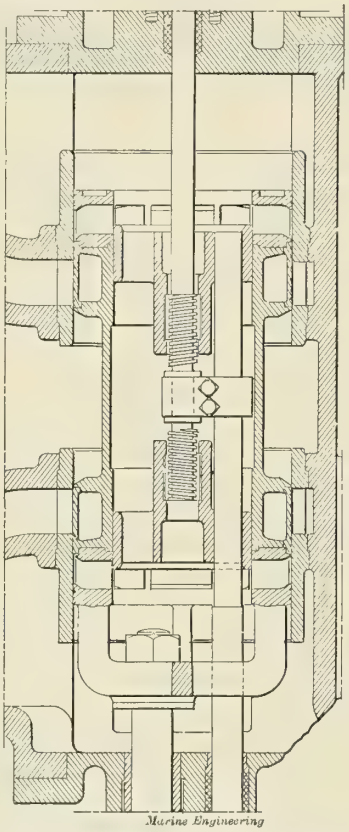
Yours truly, J. F.

We publish the above communication in the belief that it may be of interest to many of our readers, and hoping that it may elicit replies from those whose experience has led them to give attention to the point in question. In the practice of the Advisory Editor, who writes here simply as an individual, it may be said that the line of support furnished by a flange or by a row of tubes properly beaded over or fitted with stay tubes has been considered as equivalent to that furnished by braces of the regular type, and the spacing of such braces has been arranged in accordance with this suggestion.

We shall be glad to hear from any of our readers who may have an opinion to offer on this point.

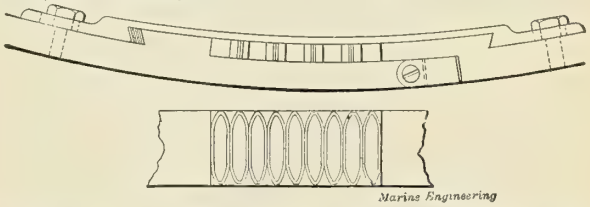
SELECTED MARINE PATENTS.

697,839. CUT-OFF VALVE MECHANISM. JOHN HAUG, PHILADELPHIA, PA.



CLAIM.—3. The combination of the tubular main valve, the duplex cut-off valve contained therein and the adjusting screw for said valve having collars thereon at a point between the two members of the valve, the cut-off-valve stem located on the inside of the main valve, and a two-part clamp engaging said stem and embracing the adjusting screw between the collars of the same. Three claims.

703,590. EXTENSIBLE PISTON RING. OTTO JOHNSON, BROOKLYN, N. Y.



CLAIM.—1. A rabbetted slip joint for connecting the meeting ends of a circumferentially-extensible piston ring, the said joint composed of a relatively long overlapping member provided with an inwardly-projecting boss; and an inward offset forming a relatively shorter underlapping member; an expanding-spring system interposed between said boss and the opposed end of the said inward offset forming said underlapping member; a locking bar provided upon its radially outward face with a recess for receiving said boss and said inward offset; a system of liners appropriately introduced into said recess for limiting to a prescribed extent the circumferentially-expanding influence of said spring system upon the members of said joint. Five claims.

704,000. LIFE PRESERVER. GEORGE B. CONLEY, CLEVELAND, O.

CLAIM.—1. A life preserver comprising the combination of a folding framework consisting of a series of curved ribs hinged together at their respective ends, means for engaging two of the said ribs, a flexible waterproof cover secured at one end to one of the said engaging ribs and at its other end to the other of the said engaging ribs, and arranged to completely envelop the said framework. Six claims.

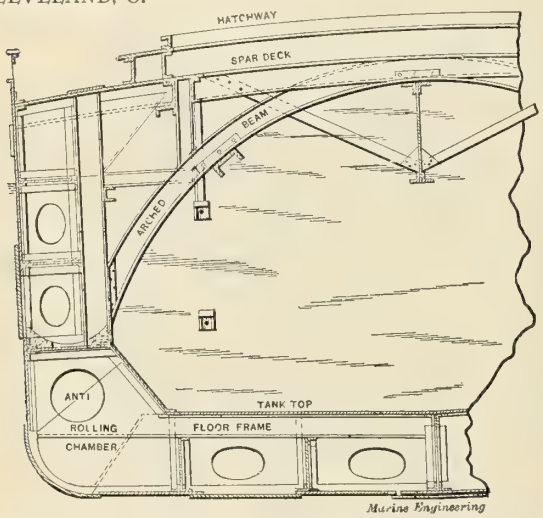
704,155. MOORING SHIPS. WILLIAM M. WALTERS, LIVERPOOL, ENGLAND.

CLAIM.—1. In combination with a ship an upwardly and backwardly sloping tube extending from the bottom of the ship near the keel, at about one-quarter of the length of the ship from the bow, to the deck; a wheel located within the tube at about the center of resistance to wind and waves, such wheel being arranged to guide the cable and means for hauling and securing the cable. Three claims.

704,186. BOAT PROPELLING DEVICE. FRANK J. GLEASON, VAN WERT, O.

CLAIM.—2. A reverse-action rowing mechanism comprising in combination with an angle lever adapted for attachment to the side of a boat, a feathering blade having integral arms which are pivoted on opposite sides of the free end of said lever, the lower end of the latter adapted to form a stop against which the face of the blade is adapted to contact during the stroke of the oar, the pivotal handle, and link connections between the same and said lever, as set forth. Two claims.

704,362. BULK-CARGO VESSEL. JOSEPH R. OLDHAM, CLEVELAND, O.



CLAIM.—1. In a vessel, the combination of arched girders spanning the hold of the vessel, transverse deck girders headed on the sides of the vessel and supported centrally by said arched girders.

2. In a hull, the combination with transverse deck girders, transversely-extending arched girders spanning the hold and supporting said deck girders, longitudinal girders connected to said transverse girders and designed to form a hatch deck, and transverse bulkheads supporting said longitudinal girders.

3. In a vessel, the combination, with a deck, of deck girders extending transversely the hold of the vessel and supporting said deck, and circular arched girders spanning the hold and supporting said deck girders.

4. In a bulk-cargo vessel, the combination, with a hull divided by transverse bulkheads, of longitudinally-extending arched girders supporting said deck and footed on said bulkheads. Four claims.

704,685. SAILING BOAT. THOMAS JENSEN, ARENDAL, NORWAY.

Three claims.

704,729. DEVICE FOR RETARDING THE SPEED OF VESSELS. AARON ZERBE, PHILADELPHIA, PA.

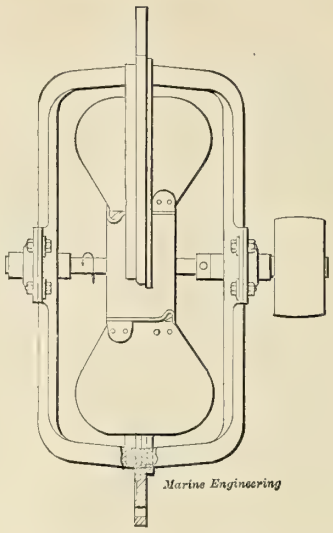
CLAIM.—1. In a device of the character described, two shafts upon each side of the boat, extending longitudinally of the boat and protruding from the rear thereof, two plates secured to the outer end of the shafts, said plates normally lying against the rear portion of the boat so as to present no resistance to the water, means located in the interior of the vessel for rotating the shafts so as to turn the plates outward beyond the sides of the vessel. Two claims.

704,905. APPARATUS FOR REPAIRING VESSELS AT SEA. NEIL J. McLAUGHLIN, BOSTON, MASS.

CLAIM.—2. A device comprising a plate provided with a pad, a rope or cable passing through said plate and pad, a locking bar attached to one end of said rope or cable, and a winding mechanism arranged upon the metallic plate for the purpose of winding the said rope or cable. Four claims.

705,046. ROTARY PROPELLER FAN AND PROPELLER FOR SHIPS. SAMUEL C. DAVIDSON, BELFAST, IRELAND.

CLAIM.—1. A rotary propeller fan or screw propeller of the disclosed type, in which the intake and discharge edge portions of each blade are formed as oppositely-dished surfaces, from approximately the central part of the peripheral edge of the blade around the margin thereof toward the hub or axle, in such manner that the advancing surface of the blade is, at the intake edge portion, substantially concave, and at the discharge edge portion substantially convex. Seven claims.



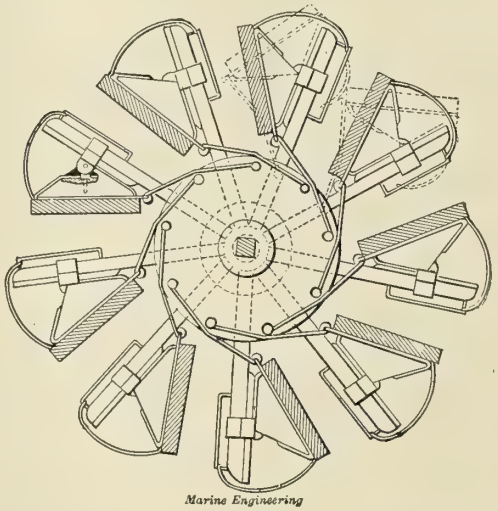
705,050. COMPASS LIGHT. OSCAR E. EATON, BOSTON, AND FRANK C. BURRILL, HULL, MASS.

Two claims.

705,188. ANTICAPSIZING DEVICE FOR BOATS. FREDERICK W. ZIMER, LONDON, ENGLAND.

CLAIM.—1. A boat provided with float supports hinged to the sides of same, a float carried by each of said supports, and a connecting rod joining the float support on one side of the boat with the corresponding support on opposite side of boat. Five claims.

705,397. PADDLE WHEEL. JOHN J. GRAHAM, IMPERIAL, PA.



CLAIM.—1. The combination, in a paddle wheel, of the shaft, the arms provided at their outer ends with the bearing plates, the adjusting wheels arranged to turn freely on the shaft, the paddle blades, the triangular rocking blocks secured at their bases to the paddle blades and provided in their apices with sockets or mortises, bands passed around said blocks and lying in the base of the said sockets and extending beyond the inner ends of the blocks, the links connecting such extensions of the bands with the adjusting wheels, the clips passed beneath the bands at the base of the sockets in the rocking blocks and provided with perforated ears, and the clasps embracing the arms and bearing plates and having lugs pivotally connected with the lugs of the clips. Five claims.

705,417. GOVERNOR FOR PROPELLER SHAFTS. WILLIAM R. MAY, NEWTON, MASS.

CLAIM.—6. The combination, with a propeller shaft, of a friction clutch comprising a fixed outer member and an inner member which is movable with the shaft, a governor shaft adjacent to the propeller shaft, a movable yoke or frame supporting the governor shaft, gearing connecting the governor shaft with the propeller shaft, said gearing including two friction members, one mounted on the propeller shaft and the other on the movable frame, said members being separable by a movement of the frame, means for moving the frame, centrifugal governor arms pivoted to the governor shaft, and connections between said arms and the inner clutch member. Six claims.

INDEXED.

Marine Engineering

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U. S. TORPEDO-BOAT DESTROYERS TRUXTUN, WHIPPLE, AND WORDEN.

The three torpedo-boat destroyers building for the U. S. Navy by the Maryland Steel Company were constructed in accordance with designs prepared by the builders, and, in general appearance and details, are entirely different from any of the others.

The accompanying plans give a very good idea of the arrangement and general design, and the dimensions will be found in the appended table. As the three boats are identical, the description of one will apply to all.

U. S. TORPEDO BOAT DESTROYER TRUXTON STARTING ON HER TRIAL TRIP.

The armament consists of two 12-pdr. r. f. guns, mounted, one on each conning tower; six 6-pdr. r. f. guns, two on each side and two on center line, and two 18-inch torpedo tubes on center line. Four torpedoes are carried, two in the tubes and two under the turtle deck forward.

The hull is divided into fourteen water-tight compartments by 'thwartship bulkheads. In addition to these, the fore-and-aft coal-bunker bulkheads divide the ship into three compartments transversely for the length of machinery space. Each bunker is divided into four compartments by water-tight bulkheads with doors. The capacity of bunkers is 185 tons.

The hull is of mild steel, with the exception of the sheer strake and stringer plate, these being of nickel steel for the length of machinery space.

The crew have quarters forward on the berth deck, with plenty of air and light. The crew's toilet and wash rooms are under the bridge deck directly above. The galley is forward of the boiler-room bulkhead, with store room and ice box underneath. Under the crew's quarters and windlass room are store rooms, awning and canvas room, ammunition, and war heads. Aft of the after boiler-room bulkhead are quarters for the firemen, with shower bath and toilet in one corner; next to these are similar compartments for the machinists and petty officers.

Entering through the after conning tower, and at the level of the berth deck, are commodious quarters for the commander on the starboard side, and for the executive officer on the port side. The officers' bath is next on the port side and commander's office on the starboard. The engineer's room is on the starboard side opposite the office. Aft of these is the ward room, extending across the ship, with pantry directly aft. The pantry stores occupy the extreme after end.

Under the petty officers', machinists', and firemen's quarters are ammunition and store rooms. The reserve

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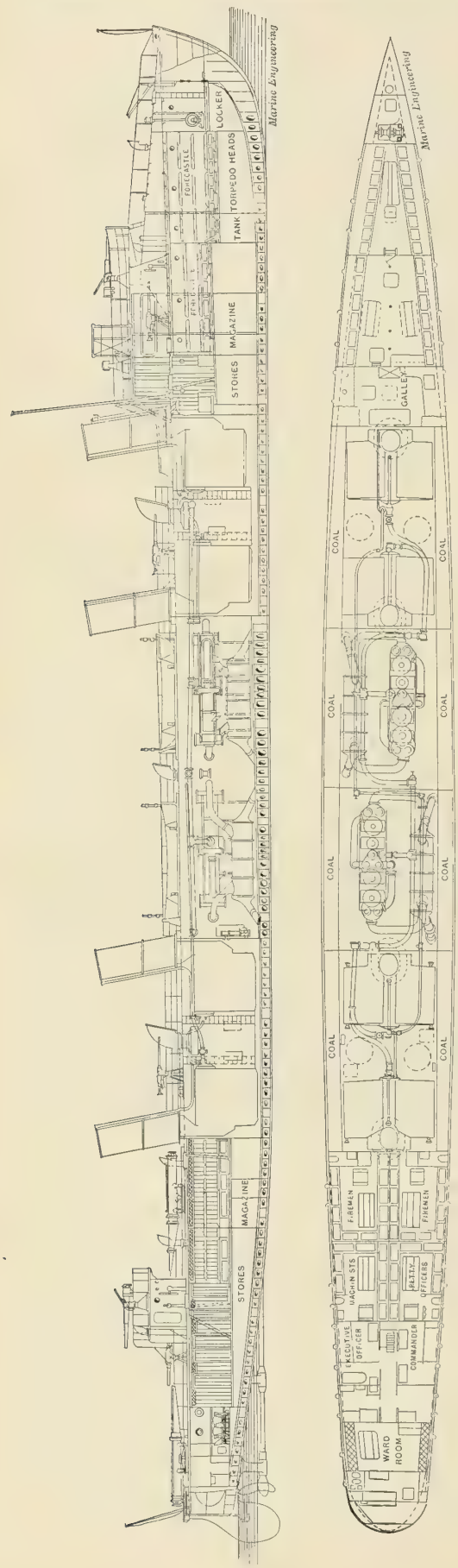

Marine Engineering
FORECASTLE
TANK
TORPEDO HEADS
LOCKER
STORES
MAGAZINE
STORES
MAGAZINE
GALLEY
COAL
COAL
COAL

The valve gear is of Stephenson double-bar link type. All the main valves are piston valves, double-ported, there being one for each high-pressure and two for each of the intermediate and low-pressure cylinders. The crossheads work in slipper guides. The framing is of forged steel vertical columns with diagonal braces. The bed plates are composed of separate steel castings, supported upon and bolted to two channels, each having the upper flange planed down. The crank shafts are in two sections, and, together with all line and propeller shafting, have an axial hole.

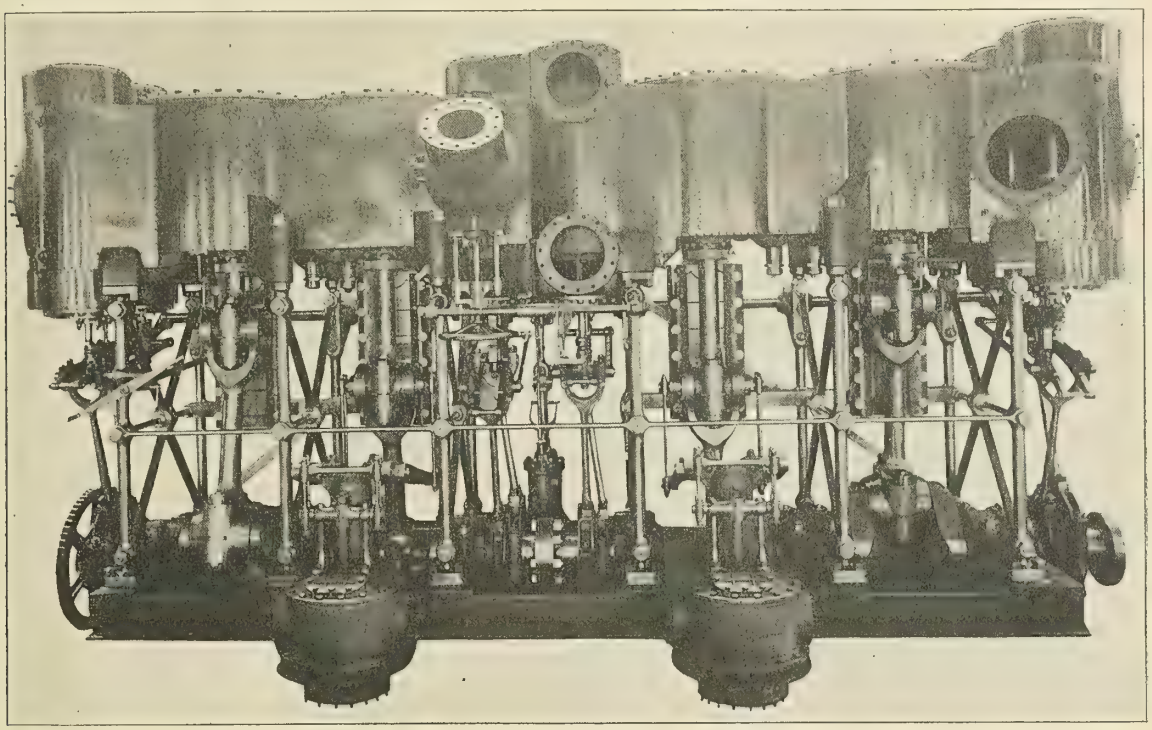
The condensers are circular, of sheet brass, each having a cooling surface of 3,470 square feet. For each propelling engine there are two double-acting vertical air pumps, driven from the high and intermediate-pressure crossheads. There is a centrifugal pump driven by a 4 1-2-inch diameter by 5-inch stroke engine on each condenser, with a connection to the 7-inch flood drain in engine and boiler compartments.

Steam is supplied by four water-tube boilers of the Thornycroft type, constructed for a working pressure of 240 pounds. Each boiler has its separate smokestack, the forward stack casing being arranged as a vent to the galley and the after one as a vent to the firemen's quarters. The four main feed pumps are of Davidson make and are located one in each engine room.

On June 25 the *Truxtun* left Pearson's wharf at 11.30 A.M. to undergo standardizing trials over the Government course off Barren island, and, after receiving the Trial Board off the mouth of the Pawtuxet, she immediately entered upon the test. In all, ten runs were made over the measured nautical mile, five runs south and five runs north. The tide was running south and there was a strong N.N.E. wind, making the sea quite rough. As can be seen from the accompanying table, the runs were very satisfactory and all the machinery worked smoothly, without undue heating or noise.

A noticeable feature was the steadiness and absence from vibration, especially at the highest speed. In turning at the ends of the course a very pretty effect was noticed. On account of the rudder being overhung, the flow of the water against the surface when at about 15 to 20 degrees helm angle caused a miniature fountain. At the highest speed the water was thrown about 8 feet above the level of the deck.

The slipping of the catch on the after fire-room hatches caused the speed for the ninth run to fall below where it would have been, but on the next run (against the tide) a speed of 29.8 knots was obtained, which, with tidal corrections, gave a true speed of 29.9 knots.



FRONT VIEW OF ONE OF THE FOUR-CYLINDER TRIPLE-EXPANSION ENGINES FOR THE DESTROYERS.

On Thursday, the 26th, after receiving the Trial Board at Pearson's wharf, the *Truxtun* started on the one-hour's run, going north for 30 minutes and south for 30 minutes.

The weather conditions were similar to those on the previous day, causing a very heavy sea. From the curves of standardization trials it was only necessary, to fulfill the contract requirements of 26 knots, to hold 153 pounds of steam, which would give 283.8 revolutions. For over an hour an average of 304 revolutions was obtained, giving a mean speed of 27.66 knots.

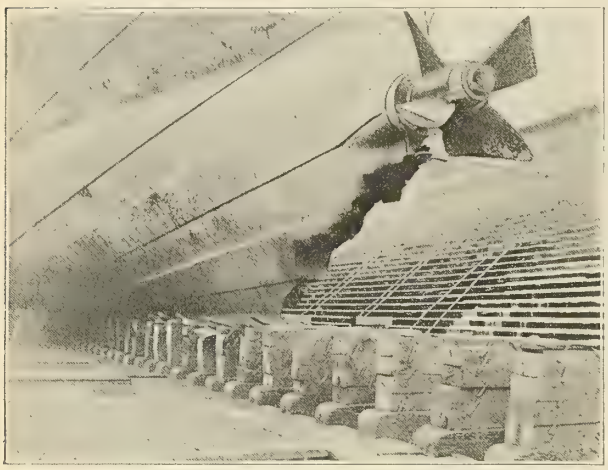
After manœuvering the vessel to test steering gear and inspection of all compartments, the Trial Board left for the *Gloucester*, and the *Truxtun* departed for Sparrow's Point to receive the finishing touches preparatory to being turned over to the Government. As this was only the fourth time the *Truxtun* had been away from

the wharf for trial runs (three being builders' trials), the results obtained are highly commendable, and, we believe, establish a record for torpedo-boat destroyers in this country.

Since writing the foregoing the *Whipple,* a sister ship to the *Truxtun,* has attained a speed on official trial of 30 1-4 knots, and on the one-hour's run averaged 27.46 knots, thus beating the *Truxtun's* record.

Steamer Hero.

The Norwegian steamer *Hero,* after being driven ashore and badly damaged, was taken by the wreckers to the dock of the Baltimore Shipbuilding and Dry Dock Company, when an examination was made which revealed very serious damages to the stern and bottom throughout, as shown in the accompanying engraving. About 200 plates had to be renewed on the bottom; the stern frame was completely demolished, and three of the blades of the propeller broken off short; a new stern frame was fitted, also rudder and the wheel. A



DAMAGED STERN OF THE NORWEGIAN STEAMER HERO.

large section of the keel had to be renewed, and the main engine and auxiliaries were dismantled. A new low-pressure cylinder had to be made, and the entire line shafting and bearings were trued up. The repairs to the upper works of the hull included entire new joiner work, new pilot house and chart room, and a main deck of Georgia pine from end to end. The winches and deck beams had to be thoroughly overhauled, and all the rigging stripped and renewed. The entire vessel, inside and out, was scaled and painted. New anchors and chains were furnished, sails were renewed, and she was equipped with new lifeboats, and, in fact, all equipment had to be renewed, so that the vessel will leave the yard equal to, in most respects, a new ship. Her dimensions are: 322 feet 3 inches long, 40 feet beam, 29 feet 6 inches deep. She was built at Sunderland, England, in 1881, and is propelled by a compound engine with cylinders 21 and 55 inches in diameter by 45 inches stroke.

STABILITY OF AN OIL-TANK STEAMER.

BY P. F. WALKER.

The effect of oil or other liquid in a ship, when the containing tanks or compartments are not completely filled, is to reduce the statical stability. This is due to the fact that as the ship inclines to one side the liquid within moves in the same direction, thus causing the center of gravity of the entire ship to be shifted horizontally toward the new position of the center of buoyancy, and so reducing the length of the moment arm of the righting couple. Looking more closely at the forms of the spaces occupied by the moving liquid, first with the ship upright and then in the inclined position, it is seen that the change has been produced by emptying the wedge-shaped space between the original and the final surfaces of the liquid on the upper side of the ship, and filling the corresponding space on the opposite side, and consequently that the change in the position of the center of gravity is due wholly to the transference of the liquid from one of these wedge-shaped spaces to the other, the two being necessarily equal in volume. It follows, therefore, that the amount of liquid present in the vessel, in addition to that necessary to fill the wedges, is immaterial so long as small angles of heel are considered, the total weight of the ship being constant and all other weights fixed. For large angles of heel the shape and size of the wedges will depend on the depth of the tanks, and hence the amount of liquid present will then have an indirect effect.

In dealing with the question of stability there are two points to be considered: First, the conditions affecting the steadiness of the ship in the upright position; and, second, those influencing the tendency of the ship to right herself after being inclined through large angles.

Steadiness in the upright position is indicated by the value of the equation for the stability moment for an angle of heel indefinitely small. This equation may be written in the form:

$$dM = D \times GM \text{ sin. } d\theta,$$

where dM = stability moment,
D = displacement in tons,
GM = metacentric height in feet,
$d\theta$ = the indefinitely small angle.

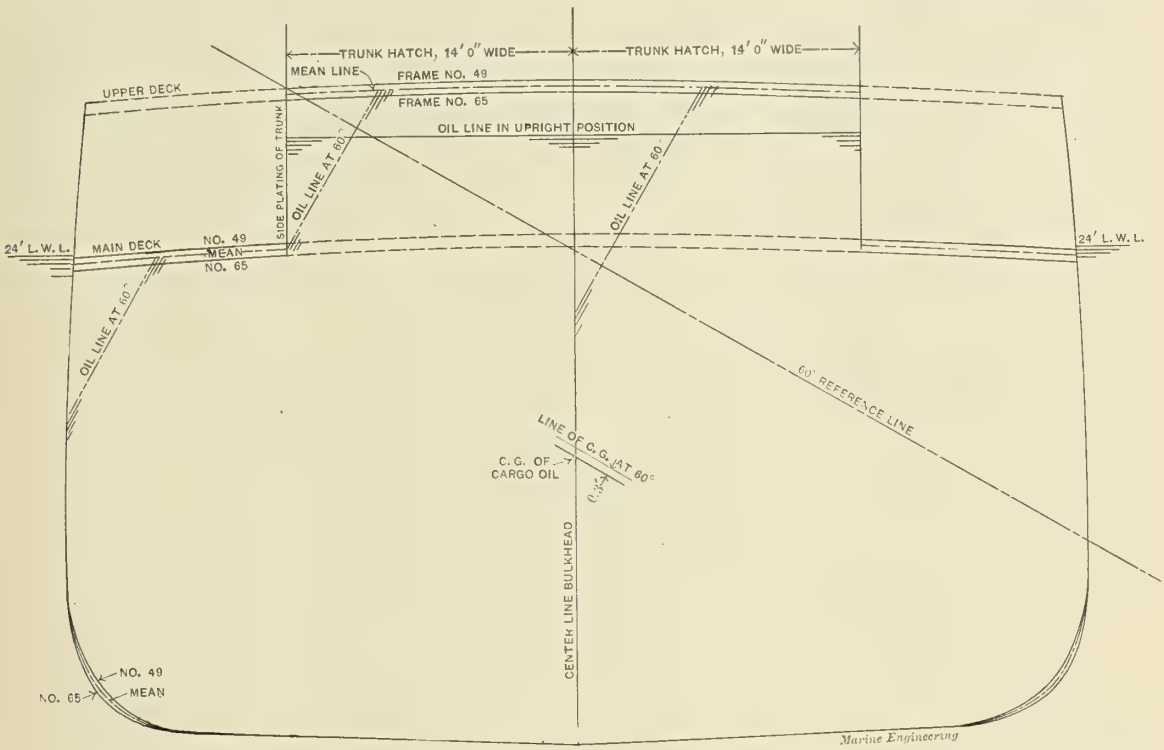
The product $D \times GM$ gives the relation between the stability moment at an indefinitely small angle and the angle itself, and therefore is a measure of the rapidity of increase in stability as the vessel starts to heel; or, in other words, it gives the direction of the curve of statical stability at the origin. For a given displacement this value is seen to depend directly on the metacentric height, and so it has been found convenient to express the influence of a free liquid surface in the ship in terms of its virtual effect on this quantity. It is shown in all standard works on Theoretical Naval Architecture that the effect of the horizontal shift of the center of gravity of a liquid, due to a small angle of heel, is the same as would be produced by raising the same weight vertically through a height equal to the moment of inertia of the free surface divided by the total volume of liquid, the center of gravity of the entire ship being thus raised in the inverse ratio of weight of liquid to weight of ship, and the virtual metacentric height correspondingly reduced.

At large angles of heel the value of the stability moment will be influenced by the value of the metacentric height for the upright position, but also by the amount of freeboard possessed by the ship as well as by certain features of form. Direct calculation, therefore, becomes necessary, both for determining the stability arm in the usual manner and the horizontal shift of the center of gravity of the free liquid. It is with this phase of the subject that the present article is intended to deal, such calculations having been made by the writer for a ship designed to carry oil in bulk and now in process of construction at one of the Atlantic coast yards.

the cargo compartments is 6,710 tons of oil at 57.22 pounds per cubic foot. With all fuel tanks filled, however, only 6,390 tons of cargo oil can be carried at 24 feet draft, and it is for this condition that the present calculation is made, the oil level in the trunks being 2 feet 3 inches below the mean level of the upper deck beams.

CALCULATION OF STABILITY FOR THE SHIP WITH FIXED CENTER OF GRAVITY.

This was done with an integrator in the usual manner. The position of the center of gravity was determined from estimated weights and leverages, a metacentric height of 4 feet 3 inches being taken, although



SECTION IN TANK NO. 2, OIL TANK STEAMER

The ship is an oil-tank steamer of the ordinary type and of the following dimensions:

Length, B. P.	374	ft. 0	in.
Length over all	399	" 0	"
Breadth, molded	49	" 11½	"
Depth at mid-length	30	" 3	"
Designed load draft	24	" 0	"
Displacement	10,391	tons.	

The oil-tank space begins about 73 feet aft of the stem and extends aft 208 feet 4 inches, 12 1-2 feet at the after end being used for fuel oil. The machinery is aft, additional fuel-oil tanks being fitted alongside of the boilers. In way of the midship tanks fore-and-aft bulkheads are fitted through the 'tween deck space, 14 feet out from the center line, as shown in the section plan, thus forming trunks 7 feet 6 inches deep. A continuous center-line bulkhead to the upper deck extends throughout the oil space, while transverse oil-tight bulkheads divide the space into six double compartments for cargo oil and one for fuel oil. The total capacity of

in ordinary conditions the value would probably be somewhat more. The integrator was placed in such positions at the several angles of inclination that the axis of moments for the instrument passed through the center of gravity. Dividing the summation of moment readings by the summation of area readings would thus give immediately the value of the stability arm, provided the water lines cutting off the true load displacement in the several angular positions were available. To avoid the difficulty of determining these true water lines, readings were taken at each angle for three water lines, 4 feet apart, and so placed that the true water line would fall within their limits. The results were then plotted on abscissa values representing displacement, a curve being drawn for each angle, giving portions of what would correspond to cross curves of stability. The values obtained from these curves for the load displacement, plotted on an abscissa scale of angles of inclination, gave the curve for fixed center of gravity shown in the accompanying cut.

EFFECT OF THE FREE-OIL SURFACE.

The virtual metacentric height was first determined. As before stated, the difference between this and the actual *GM* is obtained by dividing the moment of inertia of the free surface by the volume of the liquid, and then multiplying by the ratio of weight of liquid to displacement, or weight, of the ship. Since the moment of inertia of area varies as the third power of the breadth of surface, it is seen that the introduction of the center-line bulkhead and the trunks, so dividing the oil surface into two portions, each approximately one-fourth the total breadth of the vessel, reduces this quantity to approximately one-thirty-second of what its value would be for the complete, unbroken surface. In the fuel-oil space, however, the level was assumed to be below the main deck, since this condition must be reached during a voyage. Completing the calculation on this basis, a reduction of 0.35 foot in the metacentric height was found, making its virtual amount 3.9 feet.

The horizontal shift of the oil at successive angles of heel was determined in much the same manner as was the stability arm in the fundamental calculation. As the oil level in the different tanks would differ, due to the rise of sheer forward, the tanks were taken separately. By drawing in mean deck lines and mean lines at the bilges in the two forward tanks, the other tanks being within the parallel mid-body of the vessel, only one reading from the integrator for each tank was necessary. In this part of the work the true oil line for each tank and at each angle was determined, as is shown in the section plan for tank No. 2 at 60 degrees, the ship being inclined to starboard. The line for the starboard half of the tank was readily determined by making the triangular-shaped section above the oil line equal to the nearly rectangular section above the line for the upright position. On the port side, however, it is seen that as the vessel inclines, as soon as the triangular section cuts below the bottom of the trunk the air imprisoned above will begin to pass below the main deck plating, continuing as the angle increases, until the oil rising in the trunk cuts off further passage. The final oil level will, therefore, be as shown in the plan. These lines may be drawn in on the regular body plan, but it is desirable that a special plan be made to avoid confusion. This being done, the integrator readings were taken, with the moment axis of the instrument passing through the center of gravity of the oil in the upright position, the shift of the oil center being thus directly found. The shift of the center of gravity of the entire ship bears the same relation to this result as does the weight of oil to the weight of the ship.

The dash-dot line on the curve sheet shows the result of this calculation for angles up to 90 degrees. The ordinates of this curve, subtracted from those of the curve first determined, give ordinates for the true stability curve for the stated conditions.

In connection with the above calculations an investigation was also made to determine the effect of bilging two oil compartments on one side of the ship. Such condition might be produced by injury to the shell plating near one of the transverse oil bulkheads. Only the statical effects were considered, and for inclinations in the transverse direction only. The same conditions would be fulfilled by assuming that the breach in the enveloping shell was of sufficient size to allow the water to pass in and out without restraint as the vessel rolled among waves. It is evident that this would be the most dangerous condition.

After bilging, the oil would pass out of the vessel until its level fell to such a point above the breach that the head of water outside and of oil within became of equal effect. This would be true when those heads were in the inverse ratio of the densities of the two liquids, that is, 57.22 to 64 for salt water. The oil within, assuming that no interchange of position occurred, would then be supported by the water pressure from without, and the weight of oil originally in the affected compartments would thus be removed from the ship. Correspondingly, the ship would lose buoyancy to the amount of the volume of the same compartments up to the original load water line. The ship would, therefore, rise or sink in the water, according as the weight of oil removed were greater or less than the buoyancy lost, the change in draft, if the ship be assumed to remain upright, being equal to the difference between these two quantities expressed in tons, divided by the tons per inch of immersion for the water plane as reduced by the area through the injured section. If the center of the injured compartments, measured in the fore-and-aft direction, be at the center of gravity of the original load water plane, no change of trim would occur. Otherwise the change of trim could be readily determined and any necessary corrections made in the stability calculations. Such corrections would not, however, usually be considered necessary for the changes of trim possible under the given conditions.

For the ship under consideration it was found that the lost weight exceeded the lost buoyancy, and consequently that the ship would rise in the water. This would increase the freeboard and hence the stability at large angles, other values remaining constant. The ill effects of a reduced reserve buoyancy—that is, of buoyancy above the water line—would here be lessened because of the initial list which the ship must take away from the affected side. Therefore it seemed that the metacentric height was the only factor to be investigated, provided its value should not be found to be materially reduced.

To do this the results of four changes were to be considered.

First. Due to the rise of the vessel in the water, the center of buoyancy, relative to the center of gravity of the ship, would be lowered, thus lowering the metacenter. This would, however, be opposed by the fact that the center of gravity of the lost buoyancy was relatively low.

Second. The moment of inertia of the water plane would be reduced, thus lowering the metacenter by shortening the metacentric radius.

Third. The volume of displacement would be reduced, thus raising the metacenter by lengthening the metacentric radius.

Fourth. The center of gravity of the ship would be raised or lowered according as the center of the weight of oil removed were below or above the original center of the ship.

Of these changes, the effect of the first and fourth was found to be inappreciable. As between the second

and third, the latter was found to be of greater moment, and consequently the net result was an increased metacentric height.

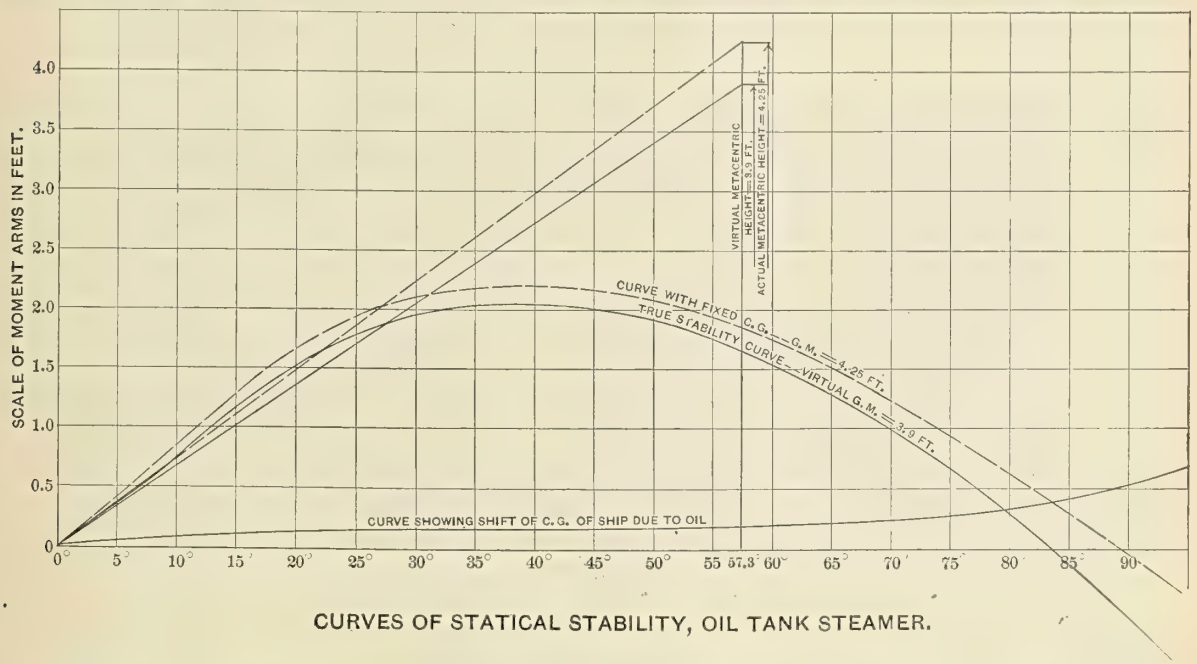
The amount of the permanent list that would be given the vessel is readily determined in an approximate manner. Writing again the equation for stability moment for a small angle, making that angle equal one degree and putting the sine of the angle equal to its circular measure, as is very nearly true, we have:

$$M = D \times GM \times 0.01745,$$

where M = moment to heel the ship one degree.

The total moment tending to heel the ship is found by multiplying the difference between the lost weight and lost buoyancy by the distance of its center of gravity out from the center line. This quantity being divided by the value of M, found above, gives a first approximation to the number of degrees of heel. If the angle so found be small it may be sufficiently correct to satisfy practical considerations. If large, the new metacentric height and the new value of M in this inclined position should be calculated and the first result corrected for a mean value of M. Following through this process for the case in hand gave an angle of heel of about 7 1-2 degrees.

From the above series of investigations it is evident that with the metacentric height assigned ample stability is assured for oil steamers of this class. Trunks of greater width could not be adopted with safety, however, nor could the oil level be much lower in the trunks without greatly increasing the effects of free surface after a moderate angle of inclination had been reached. This is shown by the marked rise in the curve showing effects of free surface, beyond the angle where the oil level in the port tank cuts under the main deck plating. With a lower oil line this rise would begin much earlier. The effects of bilging compartments are evidently much less serious than with vessels carrying solid cargoes.


SCALE OF MOMENT ARMS IN FEET.
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
0° 5° 10° 15° 20° 25° 30° 35° 40° 45° 50° 55 57.3° 60° 65° 70° 75° 80° 85° 90°
VIRTUAL METACENTRIC HEIGHT = 3.9 FT.
ACTUAL METACENTRIC HEIGHT = 4.25 FT.
CURVE WITH FIXED C.G. G.M. = 4.25 FT.
TRUE STABILITY CURVE—VIRTUAL G.M. = 3.9 FT.
CURVE SHOWING SHIFT OF C.G. OF SHIP DUE TO OIL

CURVES OF STATICAL STABILITY, OIL TANK STEAMER.

School of Naval Architecture at Cooper Union.

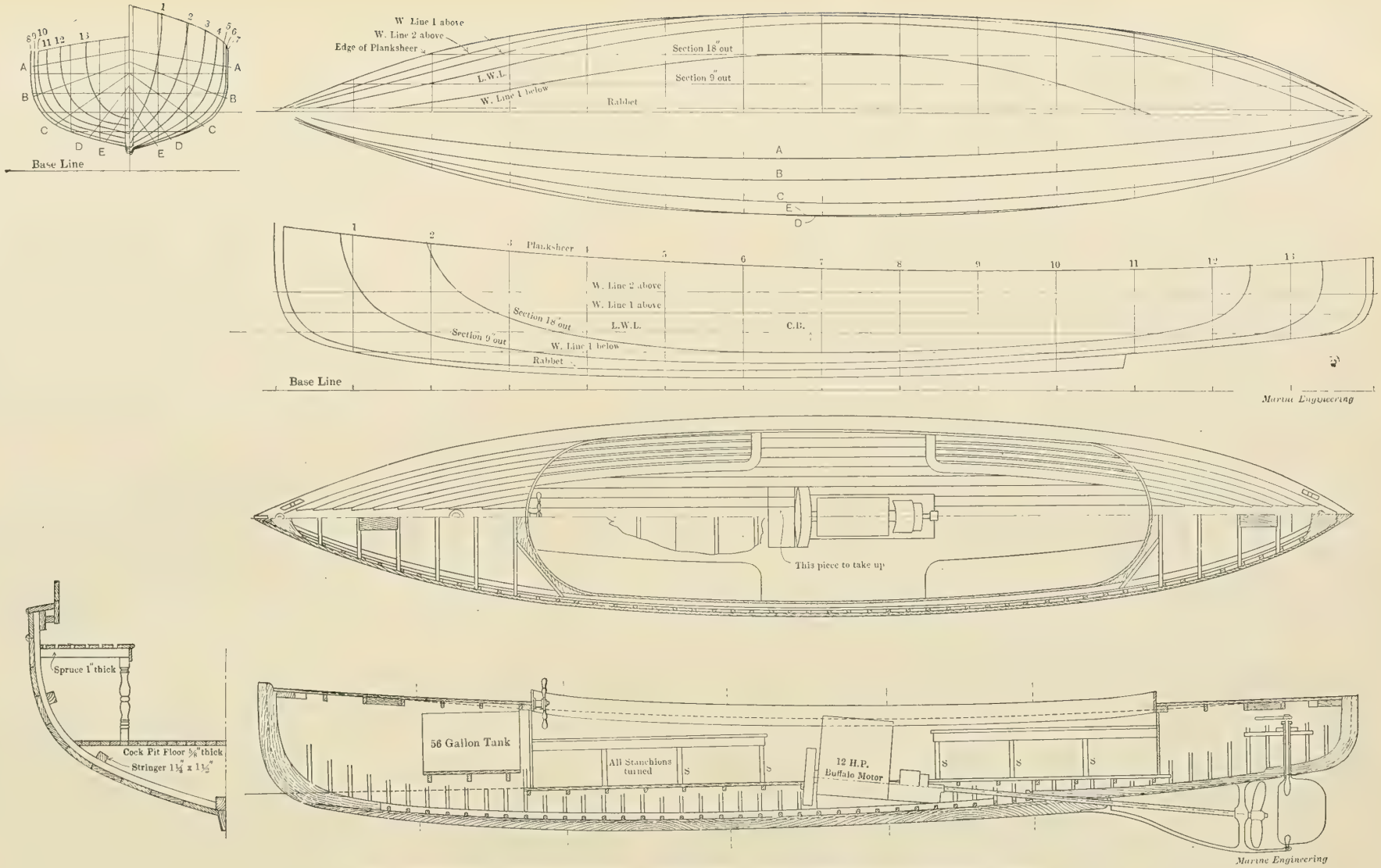
We are glad to learn that the trustees of the Cooper Union for the Advancement of Science and Art have added Naval Architecture to their night school curriculum, and have engaged the services of Prof. Alex. J. Maclean, of the Webb Academy, as its first instructor. This class was organized on Monday evening, September 22, and will be continued each Monday during the winter and spring months. Applicants can be registered at the office of the director at Cooper Union, and they should have some knowledge of elementary algebra and geometry; but these subjects, together with elementary trigonometry, can be acquired during the first year by attending the Night School of Science.

A similar school was started four years ago at the Franklin Institute, Philadelphia, by Prof. Maclean, and has met with marked success, many of the graduates having secured lucrative positions in the government service and in private yards.

Understanding the great value of this instruction to their employees, the Messrs. Cramp and Sons sent their apprentices to this class, paying their fees and giving special prizes to the most successful ones. Messrs. C. H. Cramp, H. W. Morse, Clement A. Griscom, and Lewis Nixon gave valuable prizes each year for the successful students in this class.

Since there are no fees charged at the Cooper Union, a larger attendance than that at the Franklin Institute will doubtless follow. Special prizes will be given by interested firms in the city. This class should obtain its students not only from the employees of the different shipbuilding and repairing yards in and about New York city, but also from shipowners, yacht and ship brokers, and maritime lawyers' offices.

The course of instruction embraces theoretical naval architecture, and ship construction and design. These two branches are subdivided under various heads, and will be presented in the form of lectures.



LINES, CABIN PLAN, AND ELEVATION OF A HIGH-SPEED LAUNCH DESIGNED BY FREDERICK S. NOCK.

High-Speed Launch.

The speed launch shown in the accompanying plans is one of three built last spring from the designs by Frederic S. Nock, of West Mystic, Conn.

The dimensions are: Length over all, 28 feet; length on the water line, 26 feet 6 inches; breadth, extreme, 5 feet; draft to rabbet, 11 1-2 inches; draft to the bottom of the skeg, 2 feet.

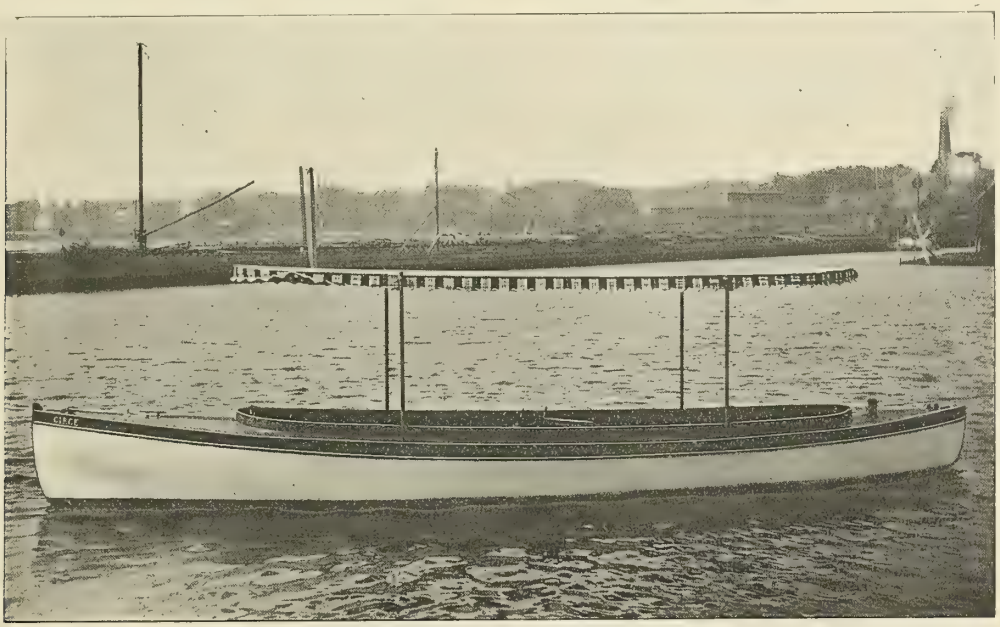
These craft are very strong and light, and, though designed for speed, the owners did not care to sacrifice every comfort in order to attain as much speed as was possible in a boat of this size.

The keel is of white oak, sided 3 inches and molded about 4 inches; the frames of white oak, steam bent, are 1 inch square and spaced 6 inches on centers; where it was possible they were in one piece from sheer to sheer, crossing the top of the keel, and strong bent oak floors secured the lower ends of them to the keel, and a heavy oak keelson was mortised over the frames and floors and securely bolted to the keel. A yellow-pine clamp, 7-8 inch by 3 1-2 inches, securely fastens the heads of the frames and sheer strake, and to further strengthen the framework a couple of bilge stringers of yellow pine, respectively 1 1-4 and 1 1-2 inches square, were secured to each side. Clear white cedar 3-4 inch in thickness was used for the planking, same being put on in narrow strips and secured to the frames with brass screws, the heads of which are sunk and the holes filled with wood plugs. The entire interior is finished in mahogany.

The seats are made with slatted tops, and this was done so as to keep the weight down as much as possible. The beams for the cockpit floor are fastened to the frames on each side of the boat, and the floor boards of white pine are fastened down with screws to admit of their removal at any time. The deck, of clear white pine, was laid in narrow strips sprung with the plankshear and nibbed into the king plank, the seams being calked with yacht cotton and finished flush. The fore-and-aft logs for the engine bed are 6 feet long and extend from the foreside of the engine aft to the shaft log, being mortised over the frames and fitted tight to the planking, with fastenings through frames and planking. The athwartship pieces are mortised into the logs and bolted through and through, making a very strong bed.

Gasoline is carried in a tank at the after end of the forward deck, the tank having a capacity of about 56 gallons, or one barrel, and so arranged with partitions as to prevent the liquid from swashing around when the boat is in a seaway.

The motor, which is one of the latest types of high-speed gasoline engines manufactured in the States, is by the Buffalo Gasoline Motor Company, and rated by them as 14 H. P. They are light, compact, and strong, and can be run from 200 to 1,000 revolutions per minute, at the latter speed developing more than their rated power.



TWENTY-EIGHT-FOOT HIGH-SPEED LAUNCH.

The arrangement for the ignition of these motors is original with the builder, as also the method of changing the spark from early to late, or *vice versa,* it being controlled by a small lever under the control of the operator at all times. The four cylinders are cast in one piece, the same being set on the base and made rigid by six round steel rods. The two center cranks are set opposite to the two end ones, and the ignition occurs at such times as to reduce the vibration to a minimum. The crank chamber is arranged with aluminum doors at each side to admit of access to the interior. The lubrication of the cranks, etc., is well arranged, the lower part of the base being filled to a certain limit with oil into which the cranks splash. This supply of oil is constantly kept up by the overflow from the oil cups which lubricate the pistons, and any excess above a certain point flows to a tank.

The propeller is three-bladed, 20 inches in diameter, 30 inches pitch, and at 600 to 650 revolutions per minute has developed over 12 1-2 miles per hour.

SURFACE CONDENSERS.

BY C. C. ROBBINS.

An article on steam condensers, recently appearing in the technical press, presents again Mr. J. M. Whitham's formula for proportioning the cooling surface of surface condensers. Some years ago Mr. Whitham developed this formula from the data of tests made on the U. S. S. *Dallas*, and it was put forth at the time as giving practically correct results only for conditions similar to those under which the data were obtained, and as being decidedly superior to the various "rules of thumb" then in vogue. The formula is as follows:

$$\text{Sq. ft. of surface} = \frac{W \times L}{U \times (T - t)}, \text{ in which}$$

W=pounds of steam condensed per hour.

L=latent heat of steam at condenser pressure.

U=heat units transferred per sq. ft. per hour for each degree of difference between steam and water temperatures.

T=temperature of steam at condenser pressure.

t=average temperature of cooling water,

= half the sum of the entering and leaving temperatures.

The values of L and T are obtained from any table of properties of steam, and U is taken as 180 and 210 for brass and copper tubes, respectively. It was based, as all such formulas are, on the transmission of a certain number of heat units per hour per square foot of surface for each degree of difference between the steam temperature and the average temperature of the cooling water.

Thus the numerator $W \times L$ evidently represents the total heat units to be taken from the steam, since steam gives up in condensing practically only its latent heat. And the denominator $U \times (T - t)$ plainly represents the heat transmitted by one square foot of surface.

This formula, while practically correct for ordinary condenser conditions, contains one or more assumptions which seriously affect its accuracy over a wide range of temperatures, such as are found in feed-water heaters and other apparatus in which heat is transferred from steam to water through thin metal partitions. Unfortunately, lack of knowledge of this fact has led to its application to cases for which it was never intended, and the results have not always been satisfactory.

The most serious error lies in assuming the average temperature of the water to be its arithmetical mean, or half the sum of the initial and final temperatures. This is not strictly correct. When the water first enters the tubes the difference in temperature between it and the steam is great and the water takes up heat rapidly, reaching its assumed average long before leaving the condenser. But as the final water temperature is always much below that of the steam, it continues to absorb heat as long as it is in the condenser, and its true average temperature is much higher than the assumed average. This decreases the amount of difference and consequently the heat transmitted per square foot of surface. This fact led to the derivation, by Mr. C. P. Poole, of a formula giving the correct average temperature of the water and therefore applicable to all ranges of temperatures. This formula, which involves the use of hyperbolic logarithms, is rather formidable in appearance, but is very simple in application. Arranged for condensers, it is as follows:

$$\text{Sq. ft. of surface} = \left(\frac{H - h}{F - I} \times \text{hyp. log.} \frac{S - I}{S - F} \times W\right) \div U,$$

in which

H=heat units in one pound of steam at condenser pressure.

h=heat units above 32° in one pound of condensed steam.

S=temperature of steam at condenser pressure.

F=final temperature of cooling water.

I=initial temperature of cooling water.

U=heat units transferred per hour per sq. ft. per degree of difference, as before.

W=pounds of steam condensed per hour.

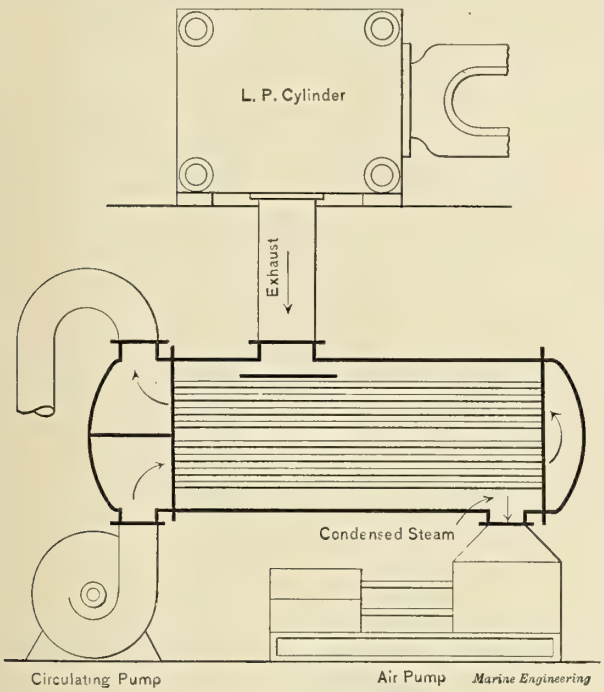
This formula takes cognizance of the fact, ignored by Mr. Whitham's formula, that the temperature of the condensed steam is always lower than that due to the pressure in the condenser; in other words, that more than the latent heat is abstracted from the steam. An inspection of the cut will show this. The presence of air in the condenser will keep up the absolute pressure, but the steam, after condensing upon the upper tubes, has to pass over the remaining lower tubes before it reaches the outlet. These tubes are much cooler than the upper ones, since they receive the coldest water, and they will continue to abstract heat from the steam after it is condensed. There is very little available data concerning the exact temperature of the condensed steam in practice, but it is probably safe to assume that it is about ten degrees lower than the steam or vacuum temperature.

To make an article of this kind of any value in proportioning new condensers or in checking up proposed designs, it is necessary to give not only the formula and the approximate values of the various factors, but to show how these values are obtained and what are their limits. In this formula, the total heat, H, in one pound of steam is taken by some engineers as the heat in a pound of steam at the condenser pressure. Other engineers claim that it should be taken as the heat of steam at the terminal pressure at which it is discharged from the engine cylinder. This terminal pressure is always much higher than that in the condenser, and the steam of course contains more heat. The difference, however, is very slight, steam at 25 inches vacuum containing 1,120 heat units per pound, and at 10 pounds gage pressure, 1,155 heat units. It is safe, then, to assume the value of H in the formula as 1,150 for all degrees of vacuum; the difference will not appreciably affect the amount of surface, and the number is easily remembered.

The maximum final temperature, F, of the cooling water evidently depends largely upon the temperature of the engine exhaust. In the usual form of condenser the hottest water passes through the upper tubes, where it meets the hottest steam; and in order that condensation may readily take place, it is necessary that the temperature of the leaving water be considerably below that of the entering steam. Again, even if it were desirable, it is impossible in the best designed condensers to raise the temperature of

the water to that of the steam, since only a part of the water can be brought into contact with the hot tube surface. Some of the water must escape without touching the cooling surface. This maximum water temperature, F, can very properly be taken at 15 to 18 degrees below that of the steam, say 16 degrees. If it is allowed to approach much nearer to that of the steam, an abnormal amount of surface will be required. If more water is circulated and the final temperature lowered, the cooling surface will become more efficient because of the greater difference between the steam and average water temperatures.

The allowable working value of the initial water temperature, I, plainly depends upon the locality and the source of supply. Even in temperate climates, where the supply is obtained from a large body of water, it is proper to assume a temperature of not



ARRANGEMENT OF CONDENSER.

less than 60 to 65 degrees, as the water will reach this point at some period of the year. In tropical climates, and in cases where the water is obtained from a shallow pond, this temperature may easily reach 80 degrees in summer. When a cooling tower is installed and the circulating water is used continuously, the initial temperature is usually about 80 degrees.

The value of U depends largely upon the condition of the cooling surface as regards its freedom from grease and scale; upon the velocity with which the water is passed over the surface, and the proportion of the entire body of water which actually comes into contact with the surface, etc. With a properly designed condenser, the velocity of the water and the motion imparted to it to bring as much of it as possible into contact with the tubes, can be made such as to allow a value of U=300 with reasonably clean tubes. If a considerable coating of grease is necessarily allowed to accumulate on the tubes, as in very long voyages, it is probable that a value of U=200 to 250 is all that may be safely allowed. Again, in some instances—namely, water-works pumping engines—steam-tube condensers are employed, in which the steam passes through the tubes. Here the value of U is comparatively very low because of the enforced low velocity of the water and the large portion of it which must escape without reaching the hot surfaces. In such cases the values in the following table must be modified in proportion to the assumed value of U.

We have now data enough to work out a numerical example, requiring only to settle the vacuum desired and to decide the initial water temperature. Let it be required to find the cooling surface to condense 10 pounds of steam per hour, producing a vacuum of 26 inches with cooling water at a temperature of 70 degrees.

The steam temperature, S,	=	125°
The value of H (assumed)	=	1150
The " " $h = 125 - (32 + 10)$	=	83
The " " $F = 125 - 16$	=	109
The " " I (assumed)	=	70
The " " U	=	300

Then

$$\text{Sq. ft. of surface} = \left(\frac{1150-83}{109-70} \times \text{hyp. log.} \frac{125-70}{125-109} \times 10\right) \div 300$$
$$= (27.4 \times \text{hyp. log. } 3.44 \times 10) \div 300$$
$$= 1.13 \text{ sq. ft.}$$

The accompanying table is worked out upon these assumptions, and gives the square feet of cooling surface and the pounds of circulating water required to condense 10 pounds of steam per hour. The upper number in each square gives the surface according to Whitham's formula, assuming copper tubes; the second number, the surface according to Poole's formula; and the third, the pounds of cooling water. It appears that the results of the Poole formula are the more nearly in accord with modern practice as observed by the writer.

The results are based on 10 pounds of steam per hour, because the steam consumption of engines per horse power per hour varies widely, and this method allows ready application to an engine of any water rate. Another numerical example will illustrate the use of the table. Let it be required to proportion the condenser surface for a 4,000-horse-power engine using 14 pounds of steam per horse power per hour under 25 inches of vacuum; cooling water from tropical waters at an initial temperature of 75 degrees.

This engine uses 4,000×14=56,000 pounds of steam per hour. According to the Whitham formula, each 10 pounds of steam requires 1.32 feet of surface, and 56,000 pounds will require $\frac{56{,}000 \times 1.32}{10} = 7{,}392$ feet. By the Poole formula we have $\frac{56{,}000 \times 1.08}{10} = 6{,}048$ feet; or by Whitham, 1.85 feet per horse power, and by Poole, 1.51 feet per horse power.

If the engine is assumed to carry 25 per cent. overload, the surface will be, of course, increased in proportion; and if, as is not uncommon, the rate of steam consumption increases with the overload, say 5 per cent., then the surface by Poole's formula will be 6,048×1.25×

1.05=7,938 feet. Another point brought out by the table is the rapid increase of surface and quantity of water required to produce the higher degrees of vacuum, 28 inches of vacuum requiring from 50 to 75 per cent. more surface than 25 inches of vacuum. Again, it appears from the table that it is practically impossible to secure the higher vacuums with cooling water at the high initial temperatures. Still another point is the advisability of having separate air and circulating pumps for cases where the temperature of the cooling water is likely to vary, as in ships trading from north temperate to tropical climates. For instance, in the above example the circulating pump is required to handle from 1,030,400 to 1,601,600 pounds of water per hour if the initial water temperature varies from 60° F. to 80° F. The load on the air pump is practically constant, and if the pumps are separate, as in the cut, the speed of the circulating pump may be changed to suit the work, while that of the air pump remains unchanged.

SPEED LIMITS IN SHOAL WATER.

BY A. D. STEVENS.

The retarding effect of shoal water on the speed of vessels is a well-known fact, and one that has been of special interest to the writer during the last ten or twelve years, in which he has been engaged in the design and construction, and, to a considerable extent, operation of steam vessels in very shallow waters. In studying the problem of speed in this class of boats, it has been noticed that on certain routes, where the water was limited, all the fast boats that have from time to time been put on these routes in the effort to beat competing vessels have somehow lost their reputed speed and proved no faster than their competitors.

Knowledge of these things has prompted a closer study of the problem, and the absence of any data of value in marine engineering publications made it neces-

Vacuum—Inches of Mercury.		24	25	26	27	28
Absolute Pressure—Lbs. per Sq. In.		2.90	2.42	1.93	1.44	.94
Temperature of Steam	$= S$	141°	133°	125°	114°	100°
Temp. of Condensed Steam	$= S - 10$	131°	123°	115°	104°	90°
Final Temp. of Cooling Water	$= F$	125°	117°	109°	98°	84°
Initial Temp. of Cooling Water = I.	60	1.00 .88 162	1.09 .93 184	1.21 1.02 218	1.41 1.16 284	1.79 1.40 455
	65	1.05 .91 175	1.16 .99 204	1.27 1.07 242	1.51 1.22 327	1.95 1.49 575
	70	1.09 .95 191	1.23 1.03 225	1.37 1.13 274	1.64 1.30 385	2.16 1.64 780
	75	1.18 1.00 210	1.32 1.08 252	1.48 1.19 314	1.79 1.39 469	2.43 1.80 1210
	80	1.26 1.24 233	1.41 1.14 286	1.60 1.26 368	1.97 1.52 600	

Upper line in each square = Surface by Whitham formula $U = 210$.
Middle " " " " = " " Poole " $U = 300$.
Lower " " " " = Pounds of Cooling Water per hour.

SQUARE FEET OF COPPER COOLING SURFACE AND POUNDS OF CIRCULATING WATER TO CONDENSE 10 POUNDS OF STEAM PER HOUR.

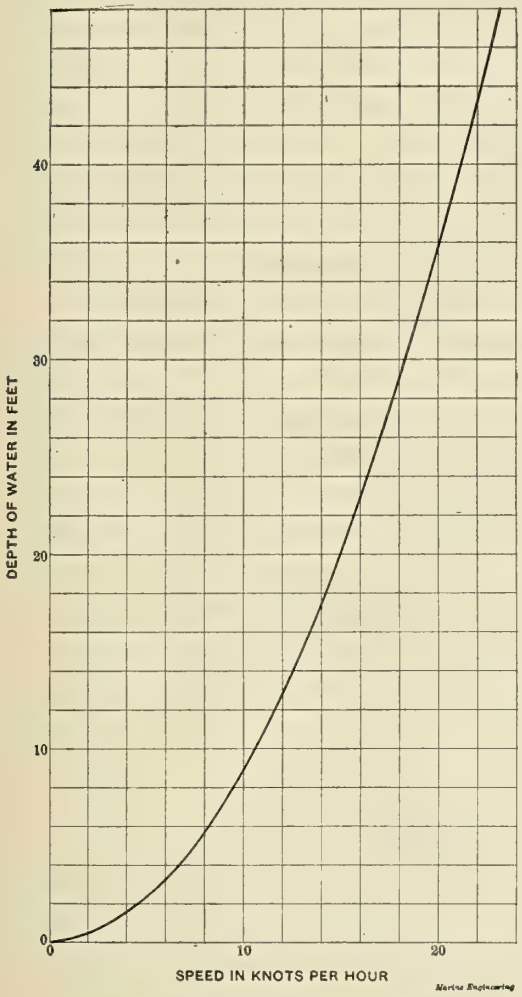
Shipyard Deal Completed.—The Bethlehem Steel Company has been formally transferred to the United States Shipbuilding Company, and the organizers of the combination state that the shipbuilding company will start in business under the new management at once. The capital has been increased from $20,000,000 to $45,000,000. Orders for two vessels have been secured.

Consolidation of Oil-Producing Property.—It is reported that the various oil-producing plants of California are to be consolidated into a $20,000,000 trust. Tank lines are to be laid from the oil fields to the cities of that state, and the object will be to build tanks for storage of fuel oil at the leading coaling stations all over the world. Thirty of these tanks are already completed, and fourteen are now building.

sary to try and find the underlying principle governing speeds in shallow waters. From an obvious course of reasoning, it would seem apparent that the solution must be looked for in connection with wave-making: for, since any vessel going through the water creates a following wave, or, more correctly, wave of displacement, traveling at exactly the same speed of the boat, it then follows that no vessel can run faster than her wave of displacement, and the relation between this wave and the depth of water will be in a great measure the solution of the problem.

Now, if the greatest speed of the boat is at the same time the speed of its wave displacement, then the greatest speed of a boat in any given depth of water is the greatest possible speed of a wave in that depth.

According to the formula of Prof. A. G. Greenhill, in *Encyclopædia Britannica,* the speed of a wave in a depth h, when h is small in proportion to the length of the wave—which is always the condition existing in the case in hand—the velocity of such a wave is expressed in the formula $V^2 = gh$, when V = velocity in feet per second, and h the depth of water in feet. By substitution, the formula reduced to knots per hour becomes $h = .089S^2$, when S = speed in knots, and is shown in the accompanying diagram. Therefore, granting (1) that no vessel can outrun her wave of displacement, for, if she did, there would be a constantly lengthening hole in the water left behind her; and (2) that Prof. Greenhill's formula is correct, then the following can be stated as the laws governing the speed of vessels in shallow water:



CURVE OF LIMITING SPEED IN SHOAL WATER.

First Law—The maximum possible speed of any vessel in shallow water is the limit of the speed of her wave of displacement in that depth of water, and,

Second Law—The maximum velocity of a wave in any shallow water of a depth h is $V^2 = gh$, which is also the maximum speed of a vessel in the same water. So much for the theoretical part. The writer has made such observations as were possible during the last four or five years since he hit upon the above theory, and would say that, as far as could be observed in the course of practical experience with speeds of from 6 to 13 knots per hour with vessels of from 12 inches to 9 feet draft, he has found no instance where the speed exceeded that given by the formula, but that the behavior of every vessel seemed convincing proof of its correctness. In smaller craft, and with speeds from 10 knots down, many observations have been made, all showing that, no matter how much power, how light the draft, or how fast the boat in good water, it could not exceed the formula speed. A boat drawing but 12 inches, and going 8 miles per hour, slacked speed just as promptly where depth fell below that given for 8 miles as did one drawing 3 feet.

The writer does not want it to be understood that the statements above are that all boats are equally fast in the same depth of water; for it is obvious that the size, and shape, and power of boats have much to do with their performance in shallow water. What is meant to be stated is that there is a limit of speed in each depth of water which no vessel can possibly exceed, but which she may more nearly approach the better she is adapted for shallow-water running. It is, moreover, certain that the effect of shoal water is often very apparent long before this speed limit is reached, and, if some series of experiments could be made in model testing tanks, possibly some law governing this effect could be discovered, or, at least, valuable data accumulated concerning the best form of hull for shallow waters. A notable instance of this shoaling effect was seen in the *Erie City-Tashmoo* race, a careful study of which will show that when the *Erie City* was slowed by the shoal water she was approaching closely to the speed limit for that depth.

This article is given as the result of personal observation and investigation, with the hope that others who have been working on the same lines may be induced to give their results, and thus throw light on a subject which is of much importance to this section (Florida), at least.

Dynamite Cruiser Dismantled.—The U. S. S. *Vesuvius,* which was armored with three stationary pneumatic dynamite guns, is to be dismantled. The Secretary of the Navy has reached this decision owing to results of many tests of this gun, both in the army and navy. A battery of these guns at Sandy Hook, costing $300,000, was recently disposed of for $20,000. During the Spanish war the *Vesuvius* demonstrated, at Santiago, the uselessness of her armament, as none of the many shells thrown by her guns took effect.

A New Diving Machine.—For the purpose of locating the wreck of the *Rio de Janeiro,* which went to the bottom of San Francisco bay about twelve months ago, John A. Bower has built a new form of diving machine which somewhat resembles a conning tower. It is of cast iron and large enough to carry a man, and has a powerful searchlight located in it, and an ingenious mechanical arm is placed on the outside and operated from within, which can be used for picking up large or small boats or for fastening grapples. In this tower the inventor intends to explore that part of the bay where the wreck is supposed to be located.

SUGGESTIONS AS TO THE PREVENTION OF CORROSION OF TAIL-END SHAFTS.*

BY JOHN BODDY.

In placing a short paper before the members of this Institute, it is not my intention to raise a discussion on the causes of failures of tail-end shafts, but rather to describe the appliances which I have used for the prevention of corrosion, together with the system of lubricating such shafts and the actual results attained.

The importance of the prevention of corrosion of tail-end shafts, and the necessity of lubrication in the stern tube, stern bush, and neck and gland bushes, will, I am sure, be agreed by all.

If some of our members who have used, and are still using, appliances for preventing corrosion of tail-end shafts and for lubricating stern bushes will kindly give us their experiences I am sure we shall one and all derive some benefit.

During the month of February, 1897, one of the steamers under my superintendence was lying in dry-dock undergoing repairs after grounding. The tail shaft at this time was uncoupled and drawn in for the purpose of being examined. It was then found to be in good order, with the exception of some slight corrosion which existed between the brass sleeves adjacent to the forward end of the after brass liner, and the lignum vitæ in the stern bush was worn down about 1-8 inch. This tail shaft and stern bush were the same age as the vessel, viz., two years. Owing to the corrosion that existed I decided to fit appliances by means of which the shaft and stern bush would be supplied with a lubricant at any time, either when the ship was laden or in ballast trim, and by this means I hoped that further corrosion of the shaft would be prevented.

A hole was drilled through the top of the stern tube, just clear of the forward end of the stern bush, to which were fitted a stopcock and a copper pipe, 1-2-inch bore, leading from top of stern tube through the peak tank, after store room and poop deck, and terminating in the cabin companion. This pipe is shown at *A* on the sectional drawing herewith appended, and was fitted for the purpose of conveying a lubricant to the tail-end shaft and stern bush.

This copper pipe was fitted with bends in the peak tank and after store room to enable it to better adapt itself to any working or vibration that might take place, and secured with clips in the peak and store room. In order to facilitate oil being poured into the pipe it was made funnel shape at the upper end, which was left open.

The object in drilling the hole in the stern tube close to the forward end of the stern bush was that the oil, after entering the stern tube, would, in addition to lubricating the stern bush, be conveyed the whole length of the shaft by the outside water pressure, and by this means the shaft between the sleeves would be coated with grease.

At the under side of the stern tube a drain pipe was fitted and led through the peak bulkhead, with a stopcock fitted on the forward side of bulkhead; this pipe was for the purpose of draining the stern tube clear of sand, grit, or other foreign matter.

*Paper read before the Institute of Marine Engineers.

The chief engineer's instructions were that, at the earliest possible opportunity after the vessel left a port and when the engines were in motion, he himself must empty into the funnel at the top end of the oil pipe one-half of a pint of engine oil, and repeat this every morning while the machinery was working. The oil used for this purpose is the same as that in use for lubricating the engines.

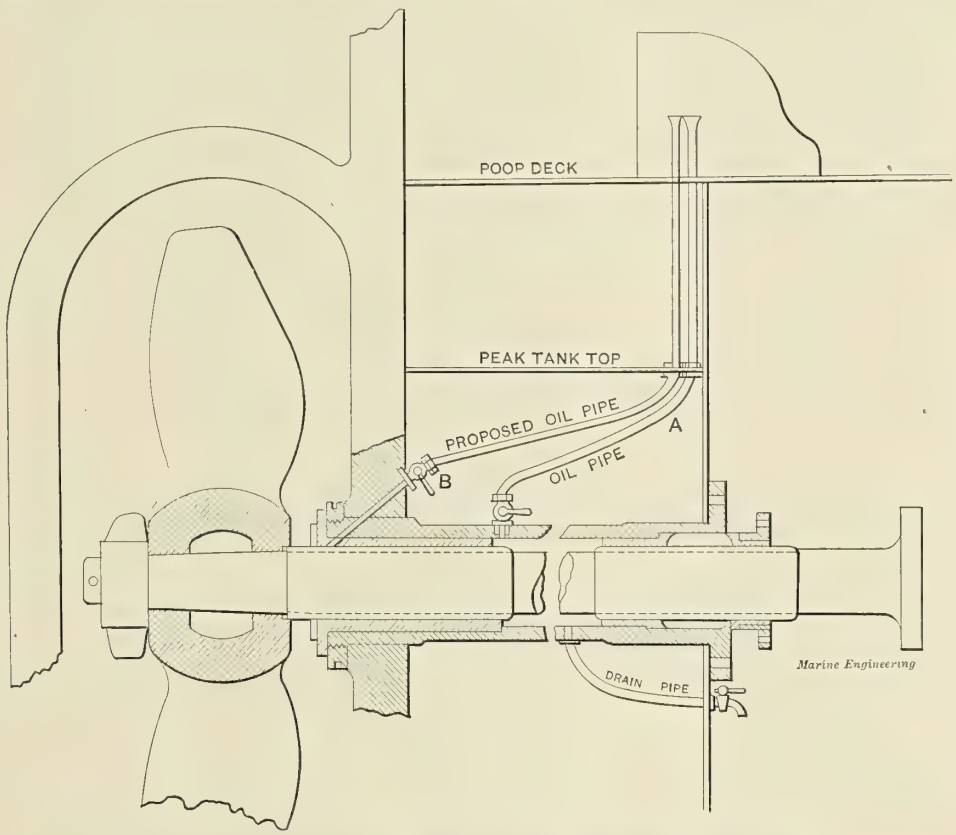
About four months after this oil pipe was fitted the vessel was chartered to proceed from Newport, in ballast, to Barry Dock to load outward. I then took the opportunity of making the trip with her, and before leaving Newport the bent copper pipe was disconnected from the stern tube and a temporary straight length of iron pipe substituted. After the vessel was clear of the port, and when the engines were running full speed ahead, I emptied one-half of a pint of oil into the top of the iron pipe. About ten minutes later I passed a sounding rod down the pipe and rested the point on the top of the tail shaft. On withdrawing the rod I found it indicated a depth of 1 1-2 inches of liquid, the shaft at this point being immersed about 2 feet. After the vessel was moored in Barry Dock, and the engines at rest, the sounding rod was again passed down the iron pipe, when it indicated a depth of about 2 feet of liquid; this corresponded with the shaft's immersion. During the run from Newport to Barry I went along the tunnel and saw that a soapy lather was oozing round the shaft in way of the stern gland. The engineer informed me that when the engines were working there was always a soapy lather at the stern gland.

At intervals during the past four and a half years this vessel's tail shaft has been drawn in for examination, and on each occasion it has been found thickly coated with grease the whole length between the brass sleeves, and quite clear of corrosion or water marks of any description. The lignum vitæ in the stern bush showed very little, if any, further signs of wear since the oil pipe was fitted, until the examination was made, viz.: During the month of March this year, when, owing to the vessel having grounded badly, she was placed in dry-dock, and, in addition to other parts of the engines being opened out, the tail shaft was recommended to be drawn in for examination.

On examining the tail shaft it was found, as on previous occasions, to be thickly coated with grease between the brass sleeves, and no corrosion or water marks of any description existed; the lignum vitæ in stern bush was found to be badly cut and damaged, and a quantity of sand and grit was found inside the stern tube. The stern bush, after having been in use for six years, was taken out, relined with lignum vitæ (end grain), machined, and replaced. The stern tube was cleared of sand and grit and washed out, and the tail shaft, which had also been in use six years, was refitted and coupled.

Other steamers under my superintendence are fitted with appliances similar to the one I have described in this paper, for the purpose of lubricating the tail shaft, stern, neck, and gland bushes, and so far have given satisfactory results. To prevent corrosion of tail shafts at the forward end of the cone, the best means I have found is to have the propeller recessed, and the brass sleeve on the tail shaft fitted and projecting into a recess about 3-8 inch, with an india-rubber ring fitted

in the recess, fairly tight, between end of brass sleeve and end of recess in the propeller. On the accompanying sectional drawing of tail shaft and stern tube you will observe, as shown at *B*, a suggested oil pipe arrangement for conveying oil from the deck to the stern bush, delivering the oil about 2 inches inside the after end of bush. I have not tried or tested this means of lubricating the stern bush, but I am of the opinion that if oil was conveyed and deposited at the after end of stern bush the outside water pressure would be sufficient to prevent the oil escaping outward, and force it the whole length of stern bush and tail shaft, and thus the stern bush would be lubricated, the tail shaft protected from corrosion between the sleeves, the neck and gland bushes would also be lubricated, and the lifetime of each would be considerably prolonged.



METHOD OF LUBRICATING STERN TUBE TO PREVENT CORROSION OF TAIL SHAFT.

DISCUSSION.

Mr. W. Simpson said presumably the method of lubrication described answered its purpose, as it was not often they heard of a tail-end shaft running for six years. Whether lubrication, however, was all-sufficient was questionable. They had heard members prove to their own satisfaction that it was the fitting of sleeves on to tail-end shafts that was the starting of corrosion. He was afraid that when once corrosion started it could not be stopped. Mr. Boddy spoke of half a pint of engine oil being put down the pipe. It seemed to him it would take a long time before the oil reached the shaft and did any practical lubricating. Some time ago he adopted a similar plan to that described, but without the drain pipe. He pumped the stern tube full of vaseline, and gave instructions to the engineer to fill the 1 1-4-inch pipe every day until he found what quantity he required to use. Most of the systems he had seen and heard of had a stern gland outside. He should like to ask Mr. Boddy if his experience led him to think that it was quite sufficient to have the pipe without the outer gland on the stern bush, whichever way it might be fixed. The speaker's shaft ran on white metal, without sleeves. It had been running about twenty months, and he had left the outer gland off, with the idea that if he had a head of oil he could force the water out. So far he had found it work all right. If he had a gland and the thing was neglected he would have no lubrication, whereas without a gland he still had the water, the same as he had before, only his was working to white metal, and this of Mr. Boddy's was brass to lignum vitæ.

Mr. T. A. Johnson said they required to first remember that the real cause of the corrosion of a shaft was galvanic action. In his experience he had come across shafts where the element of corrosion was absolutely eliminated by a patent stern tube, and the shaft broke just the same. A favorite remedy advocated was a continuous liner. A superintendent engineer had told him of the case of the *City of Rome*, where a shaft, 25 1-2 inches in diameter under the sleeves, of Whitworth's compressed steel, over 20 tons weight, with a very heavy propeller, had been running since 1880. No corrosion, no breaking of the shaft. With regard to the paper, he did not know whether Mr.

Boddy inferred that the stern tube was empty when the ship left the dock, or whether it was filled with oil prior to the vessel leaving. He presumed Mr. Boddy first filled the stern tube. (Mr. Boddy: No, sir.) Well, he had not come across the practice, but he could quite understand that the centrifugal motion which took place in the water must mix up the oil, which would gradually work on to the shaft. Yet he should have thought it advantageous to give the shaft a start by putting the oil in direct. There were other causes of fracture which should not be lost sight of besides corrosion. As they knew, he had been located in a place which was the back door to the Atlantic ocean, and of broken shafts which came in their name was legion. There was, for instance, the friendly tap of the engineer to harden up the nut. This was the cause of fracture in one case. Then he had seen lots of shafts from which big pieces had come out, the size of your fist, showing that the homogeneity of the shaft had been doubtful. But the whole crux of the matter lay in the fact that shafts had been too small in diameter. With a larger shaft they would get longer lives, which would be a bad job for the poor unfortunate ship repairer. Another cause of mischief to shafts arose from the piece of india rubber which Mr. Boddy described as introducing between the propeller and the end of the liner. Great care needed to be exercised in fitting on the rubber. He had come across four cases where the slackness of the propeller was due to the fact that the india rubber could be screwed up into such a position that it had the back tendency of a very strong spring, with the result that when the propeller was hard up against it the tendency was to drive it off.

Mr. A. R. Watson said a half-pint of oil seemed a small quantity to result in such benefit as Mr. Boddy claimed. Then he thought Mr. Boddy was wrong in the proposed lubrication of the shaft 2 inches from the end of the bush. He could not see anything to prevent the oil simply going straight out, unless there was a circulation of water coming back over the tube, which they could not have unless there was a very large drain cock running into the tunnel all the time. His own experience was that exceedingly satisfactory results were obtained from plain shafts running on a cast-iron bush, with an outside gland. One such shaft had been running over two and a half years, and the last time it was drawn in it had worn barely a thirty-second part of an inch. This was not guesswork, but from a gage made at the time the shaft was fitted new. In a good many cases of accidents to lubricated shafts that had come under his notice the defect was due to the faulty fitting of the lubricant. They could not expect to retain in a stern tube oil which had a natural tendency to flow outward and upward. Some of the older shafts with which he had to do had been running in solidified oil for about six years, with satisfactory results, both as to the wearing of the shaft and of the lignum vitæ.

Mr. D. Roberts could not reconcile the figures given by Mr. Boddy as to the sounding rod and the depths of liquid found upon an occasion ten minutes after the first. He presumed that the point of the paper was: that by getting oil on to the shaft water was prevented coming into contact with the shaft, sea water on the brass being the prime cause of corrosion, and the effect of sea water setting up galvanic action. It might be that the action of Mr. Boddy's oil had prevented an inflow of sea water into the tube. He should like Mr. Boddy's opinion upon this point, because he had never seen the experiment tried. He knew of a shaft with a liner in white metal which had been running for a period of eight years, the ship trading in dirty water and sand. The shaft was fitted with a pipe similar to that described, but a fixed quantity of oil was not put in, the oil being kept a certain head above the stern tube, the head being proportionately reduced when the ship was in light trim. The white metal was renewed last year, after eight years. On the other hand, he had a shaft the other day, barely two years old, with a very severe fracture, although there were few signs of corrosion. He considered the quality of material had a great deal to do with shaft failures. He had examined the shaft of the *City of Rome*, referred to by Mr. Johnson, with the Board of Trade Inspector, who demanded that a hole be driven at certain points through the liner. The metal came out perfectly clean, there being no sign of corrosion. At that time there was some doubt as to the after end of the liner. The propeller was fitted with a rubber ring, and there was no sign of corrosion in the position occupied by the ring. The ring was fitted just sufficient to touch the propeller when it was up at its highest position.

Mr. Simpson asked Mr. Roberts if there was an outer gland on the shaft he had spoken of as running eight years. Mr. Roberts replied in the negative.

Mr. C. W. Hansen asked if Mr. Boddy had the drain cock open at the first suffusion of oil. If not, how did he account for its getting down there at all?

The discussion was then adjourned.

(To be continued.)

Monthly Shipbuilding and Returns.—The Bureau of Navigation reports 119 vessels of 31,469 gross tons were built in the United States and officially numbered during the month of August, 1902. The largest steam vessel included in these figures is the *Siberia*, of 11,284 gross tons, built at Newport News, Va., for the Pacific Mail Steamship Company.

Wireless Telegraphy.—Admiral Bradford, who is in charge of the naval experiments in wireless telegraphy, has reported that by the Rochfort system messages have been successfully transmitted between Washington and Annapolis. Three other foreign systems are soon to be tested by the Navy, but it is evident from Admiral Bradford's report that the United States is far behind other nations in the use of wireless telegraphy.

Steam Turbines for Merchant Ships.—The application of the steam turbine to marine propulsion so far, with the exception of the two Clyde passenger steamers, has been confined to pleasure or naval craft. However, in asking for proposals for a new steamer for the Irish Sea service, the Lancashire and Yorkshire Railway Company invite alternate proposals for the ships to be equipped with the ordinary twin-screw reciprocating engines, and also for steam turbine propelling engines. The speed required is 17 knots, which is to be attained on the minimum of dimensions consistent with securing the accommodation necessary for a large number of passengers and cattle.—*Engineer.*

A Collision Bulkhead in Service.

The accompanying illustration shows in a most striking manner the possible utility of the collision bulkhead. Neither the name of the ship nor the details of the collision in which she took part are necessary to point the lesson which is here taught. The one fact which the illustration emphasizes is that in this case, at least, the bulkhead was the salvation of the ship. It will be noted how completely the bow has been torn away, and in part folded over on the bulkhead, which, on the upper part, seems to have been overlaid with planking. The inrush of water through a gaping rent, such as here shown, would, without the bulkhead, have soon filled the ship, settling more and more by the bow as the water came in. Many similar instances have occurred, and the collision bulkhead needs no emphasis placed on its possibilities for good. Rarely, however, has it been possible to show so clearly by photographic reproduction the extent of the damage and the condition of the bow after the collision as in the case illustrated in the above engraving.

BOW OF A STEAMER AFTER COLLISION; THE VESSEL WAS KEPT FROM SINKING BY THE FORWARD COLLISION BULKHEAD.

Improvements in Shallow River Navigation.

The systems of propulsion available for shallow river navigation are:

Firstly, by paddles, one being placed on each side of the vessel, which system is familiar to every one accustomed to travel on European rivers.

Secondly, the stern-wheel system, the paddle wheel being in this case placed at the stern of the hull. This plan is adopted to a large extent on the rivers of North and South America. Both these systems have the disadvantage of reduced efficiency when the vessels are loaded and consequently deeply immersed, unless feathering wheels are adopted, which is a device costly to maintain in good working order. Also the weight of this class of machinery is great, and the space occupied considerable, as compared with a screw-propelled vessel. Moreover, the wheels, especially in the side-wheel system, are exposed to damage by floating timber, and in any case the width of channel required with a side-wheeler is increased by the width of the wheels.

The ordinary screw-propelled vessel is not applicable when the draft is very limited, on account of the want of ample immersion for the propeller to secure efficiency. There is a third system of propulsion for shallow-river navigation, consisting of an arrangement of screw propeller which has been brought forward prominently of late; it combines the advantage of a large propeller combined with a shallow draft. The propeller (or propellers in the case of twin or triple screws) revolves in a tunnel formed in the bottom of the hull, near the stern. The upper part of the tunnel is considerably above the water line. This tunnel is semi-circular at the top, and dies away forward toward the midship of the vessel, and also toward the stern aft, the propeller revolving in the tunnel at its highest part, the height of the tunnel at this place being a trifle greater than the diameter of the propeller, so that its lower blades are slightly above the bottom of the boat, and therefore there is no risk of their striking the ground. When the boat is at rest, the upper part of the tunnel above the water line is filled with air, the water line in the tunnel being level with the water outside, but the moment the propeller commences to revolve the air is driven out of the tunnel and replaced by water; thus it will be seen that a propeller whose diameter is in excess of the draft of the vessel is enabled to work efficiently in a solid column of water, although not projecting below the bottom of the hull. This system has been adopted in modern times to a considerable extent, notably in a number of shallow-draft gunboats built for the British Admiralty for service in East Africa, on the Nile, and, more recently, on the China rivers. The two last gunboats of this type that have been sent out to the East bore the names of the *Teal* and *Moorhen*. For gunboats there is no doubt this system offers special advantages, but for cargo-carrying purposes, or for towing, where there may be large variations of draft, it involves a loss of efficiency when the vessel is loaded, owing to the after end of the tunnel being lower than is required at the deep draft, the rush of water from the screw striking this inclined surface, thereby forming a serious drag. At the same time, when the vessel is in its lightest condition it is necessary that the after end of the tunnel should terminate below the level of the water; otherwise air will gain access to the tunnel and completely upset the system, because in the event of air being admitted the propeller no longer works in solid water. Now the improvements recently introduced by Messrs. Yarrow and Company secure considerably increased efficiency in the loaded condition of the vessel and admit of large variations of draft. The after part of the tunnel works on a hinge, so that it can be raised or lowered to suit variations in the immersion of the vessel, the after end always being a trifle below the water level. It is easy to understand, with this arrangement, that the minimum inclination of the top of the tunnel to suit the conditions of draft can be adopted, and the serious reduction of efficiency due to the inclined surface of the tunnel is materially diminished; when the vessel is loaded so that its draft equals the diameter of the propeller, the reduced efficiency due to the rush of water striking the inclined surface of the tunnel is entirely avoided, as the after part of the tunnel would, in this case, be horizontal. The design shows a longitudinal section of the vessel recently tested. It is 75 feet in length by 9 feet 3 inches beam, and has a draft of 11 inches with steam up, but without cargo. A complete series of experiments were made to ascertain exactly the advantage due to the variation of inclination of the after part of the tunnel. It will be seen from Fig. 2 that the flap *A B*, forming the upper part of the tunnel, moves on a center *B*, and when raised up to a horizontal position the point *A* coincides with the point *C*. The usual plan is shown on Fig. 3, the after part of the tunnel being fixed. Fig. 1 shows the flap raised to its fullest extent; Fig. 2 shows the flap lowered to its fullest extent,

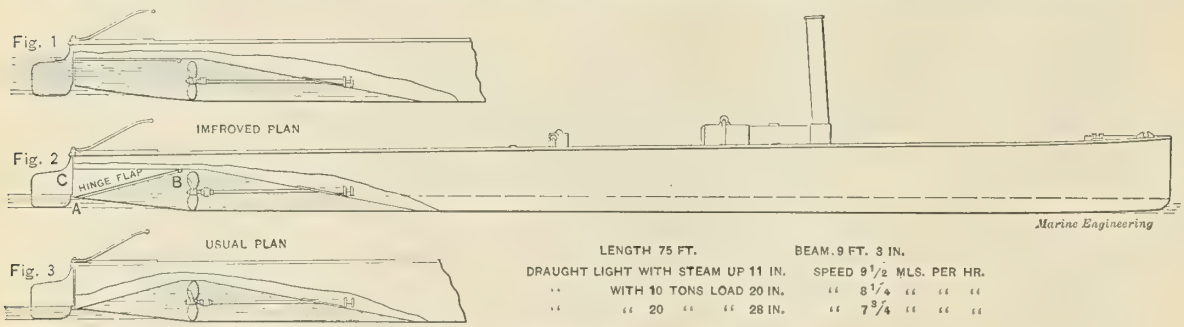


Fig. 1
IMPROVED PLAN
Fig. 2
C
HINGE FLAP
B
A
Marine Engineering
USUAL PLAN
Fig. 3
LENGTH 75 FT. BEAM. 9 FT. 3 IN.
DRAUGHT LIGHT WITH STEAM UP 11 IN. SPEED 9 1/2 MLS. PER HR.
" WITH 10 TONS LOAD 20 IN. " 8 1/4 " " "
" " 20 " " 28 IN. " 7 3/4 " " "

SHALLOW-DRAFT LAUNCH, ILLUSTRATING YARROW STERN.

corresponding to the maximum and minimum drafts of water. The curves of speed and power have been worked out for all conditions of draft.

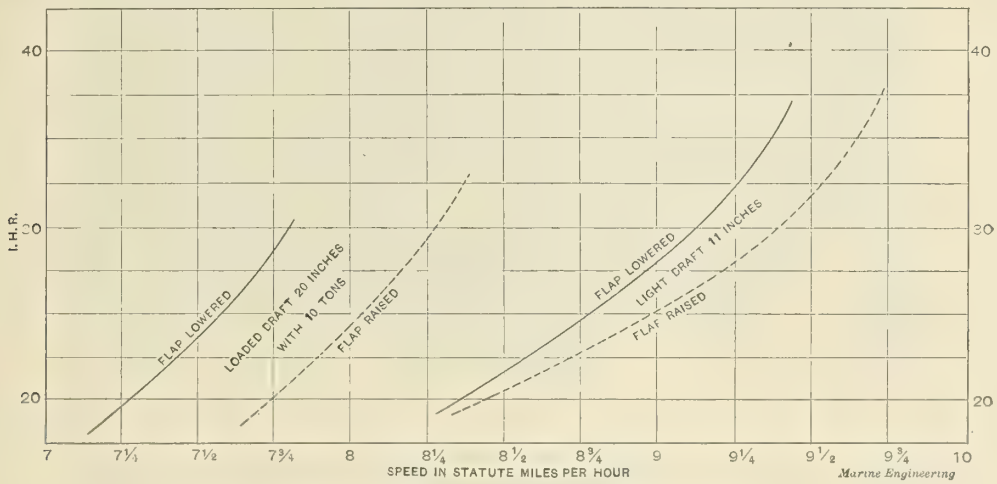
The draft light with steam up was 11 inches, and the speed 9 1-2 statute miles an hour.

With 10 tons load the draft was 20 inches, and the speed was 8 1-4 statute miles an hour.

With 20 tons load the draft was 28 inches, and the speed 7 3-4 statute miles an hour.

Now, taking as an example an average load of 10 tons, the same power is required with the flap lowered (which corresponds to the usual form of construction) to get 7 1-2 miles an hour as, with the flap raised, gives 8 miles an hour. That is to say, there is a gain by raising the flap of 1-2 a mile an hour, the power remaining the same. Now, assuming that the power required is proportional to the cube of the speed—which is nearly correct—the relative efficiencies will be approximately as 4 is to 5; that is to say, there will be a gain of 25 per cent. It was the loss of efficiency due to the water striking the inclined surface that has probably prevented this system being more extensively adopted for vessels having variations in draft, but this difficulty, it will be seen, has been avoided by the present device, and Messrs. Yarrow and Company are of opinion that for light-draft steamers this system of propulsion will probably become extensively adopted, because by this means a better combination of speed and shallow draft is obtained than by any other, together with efficiency with large variations of load.

It will be noticed that the propeller, owing to its being enclosed all round by the hull, is free from risk of damage from floating obstructions; at the same time, it is readily accessible by means of a door placed at the top of the tunnel.



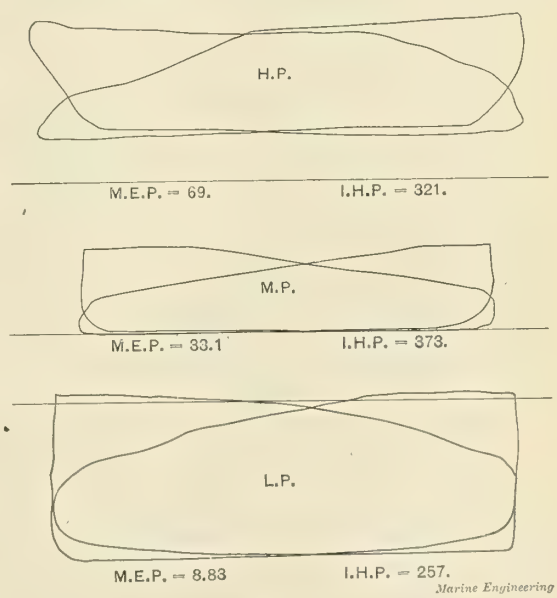
CURVES OF SPEED AND POWER, 75-FOOT SHALLOW-DRAFT LAUNCH.

Japanese Shipbuilding.—The several Japanese shipyards have recently booked orders for many large new steamers. The Nagasaki Dockyard and Engine Works are building four steamers of 6,000, 5,400, 2,500, and 1,900 tons respectively, the larger ones being for the Japan Mail Steamship Company. The other yards have four other ocean-going steamers under way.

Machinery Tests of the Steam Yacht Wacouta.

The steam yacht *Wacouta,* originally named *Eleanor,* was constructed by the Bath Iron Works, Bath, Me., 1893-94. The vessel was built for William A. Slater, of Norwich, Conn., and was especially designed and constructed as a deep-sea cruiser for circumnavigating the globe. Her voyage around the world proved very successful, steaming and sailing, as she did, 42,406 miles in sixteen months. The yacht is bark-rigged and carries an unusually large coal supply. In 1896 the *Eleanor* was chartered to various prominent yachtsmen, and in 1898 she became the property of Mrs. Cardeza, of Germantown, Pa., who, after using the vessel about two years, in turn sold her to James J. Hill, of St. Paul, Minn.

The principal dimensions and features of the yacht are given in the annexed table.



INDICATOR CARDS FROM THE WACOUTA.

The machinery was likewise built by the Bath Iron Works, and during the past winter it has been overhauled and the entire propelling plant modified by the

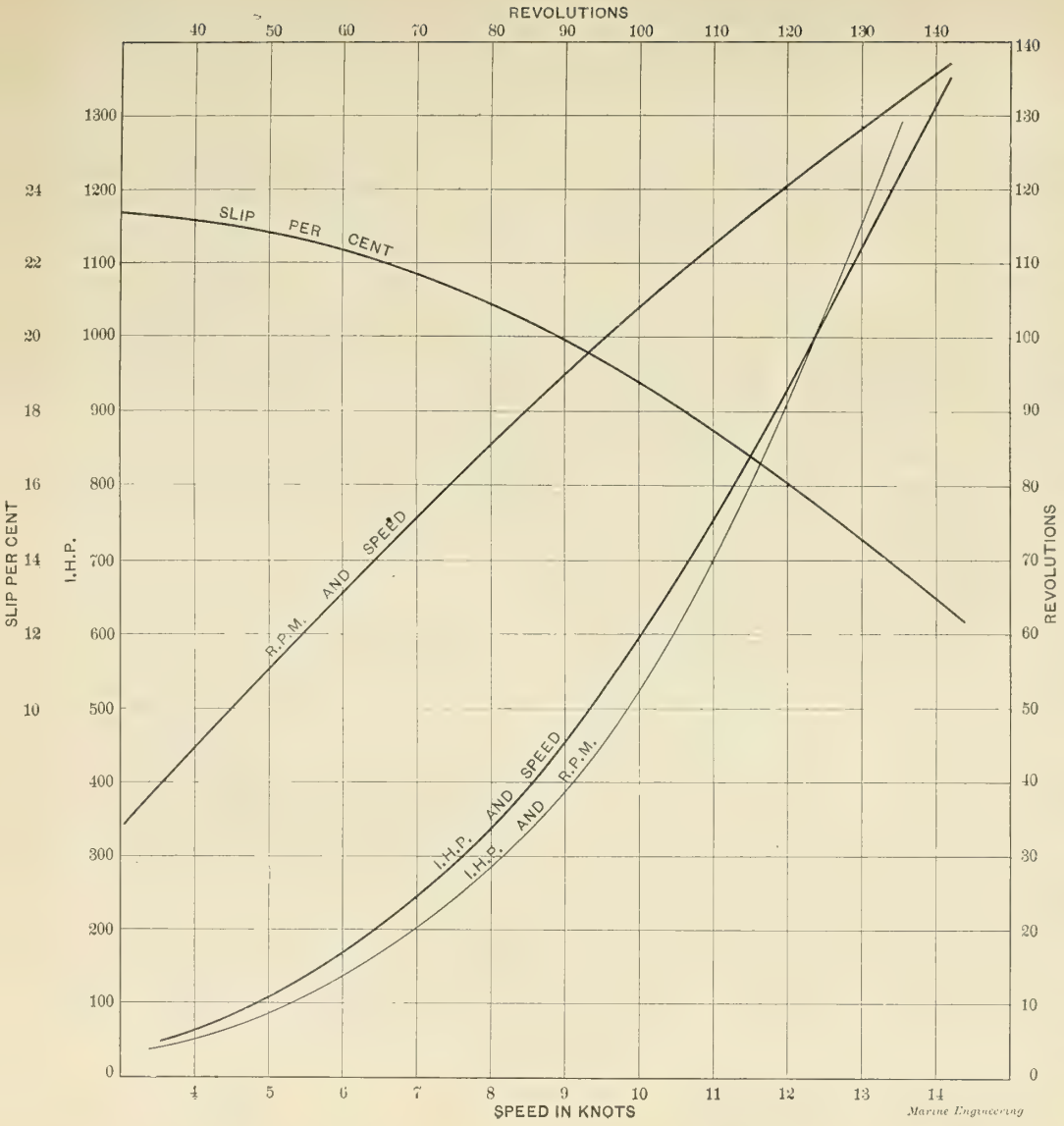
Eastern Shipbuilding Company. The latter company has also made extensive alterations in the hull and added a large pilot house forward, which has much improved the appearance of the ship. There is a three-cylinder, triple-expansion engine. The cylinders rest upon cast-iron housings at the rear, which form part of the condenser, and upon wrought steel columns at the front. There are two main boilers, and one vertical tubular boiler which is 55 inches in diameter and 10 feet 6 inches high. An independent feed pump, circulating pump, ash-ejector pump, fire pump, feed heater, fresh and salt water sanitary pump, ventilating blower, forced draft blower, ice machinery, two dynamos, steam steering gear, steam windlass and evaporator are fitted, and bilge and air pumps are worked from the main engine.

On May 3, 1902, the Eastern Shipbuilding Company conducted machinery tests off New London harbor, under the direction of Superintending Engineer William A. Fairburn, and the result of the observations made cannot fail but prove of interest. The sea was calm, with no wind, a slight mist prevailed, and the atmosphere was very heavy and damp. The vessel was in normal sea-going condition and had a foul bottom, not having been docked for nine months. During the test all the auxiliaries were run from the main boilers. During runs one, two, three, four, and five, the ice machinery, the evaporator, and No. 2 dynamo were not running, the soil ejector, steering gear in operation, also dynamo No. 1, ventilating engine room blower, and the sanitary pumps. In test No. 6 all the auxiliaries except the evaporator were in operation.

STEAM YACHT WACOUTA, BELONGING TO MR. JAMES J. HILL.

NAME—Wacouta. NATIONALITY—American. TYPE—Steam Yacht.
LAUNCHED—1893. BUILDERS—Bath Iron Works. OWNER—Jas. J. Hill.

Length over all	243 ft.	0 in.	
" load water line	208 "	0 "	
Molded beam	32 "	0 "	
" depth at side	18 "	5 "	
" " " center	18 "	11 "	
Depth of hold	17 "	5 "	
Mean draft	12 "	8 "	
" " with keel	13 "	4 "	
Draft aft	14 "	2 "	
Overhang forward	19 "	2 "	
" aft	15 "	10 "	
Freeboard forward	14 "	10½ in.	
" aft	11 "	7½ "	
Dead-rise midships	4 "	10½ "	
Tumble home midships to deck		5 "	
Gross tonnage		803.8 tons	
Net "		401.9 "	
Displacement		1,136 "	
Area midship section		316 sq. ft.	
Wetted surface		7,820 " "	
Block coef		468	
Midship section coef		.794	
Ratio length to beam		6 5 to 1	
" " " depth		11.94 " "	
" beam " "		1.94 " "	
Number of decks		2	
Spacing of deck beams		48 in.	
Spacing of frames		24 in.	
Number of water-tight compartments		18	
Deck erections	One large deck house with pilot house forward over same.		
Sail area		14,036 sq. ft.	
Coal capacity		265 tons	
Water-tank capacity		125 "	
Engines, number		1	
Diameter H. P. cylinder		18 in.	
" M. P. "		28 "	
" L. P. "		45 "	
Stroke		30 "	
Designed revolutions		125	
" I. H. P		1,000	
Cooling surface		1,129 sq. ft.	
Air pump		21 in. by 9 in.	
Boilers		2 single-end Scotch	
Total H. S		4,016 sq. ft.	
" G. S		120 " "	
Ratio H. S. to G. S		33 46	
Ratio G. S. to calorimeter		6.77	
Diameter of boilers		12 ft. 5 in.	
Length " "		11 " 7 "	
" " grate		6 " 0 "	
Diameter of furnaces		42 "	
Number of furnaces, each boiler		3	
Coal per I. H. P. average		1 93 lbs.	



TRIAL DATA TAKEN ON THE STEAM YACHT WACOUTA.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.
Period of time, minutes ...	37	30	30	30	60	42
Total number of engine rev..	1,790	2,285	3,103	3,605	7,545	5,345
Average rev. per minute.....	48.4	76.16	103.14	120.16	125.66	127.26
Maximum " "	51	77	103.5	121	134	133
Minimum " "	47.5	75 5	103	119	115	117
Vacuum, inches.	26	27 1-2	26 3-4	26 1-2	26.4	26 1-4
Steam press. at boilers, lbs....	155	155	154	148	153	155 to 142
" " engines, "	154	154	151.5	143 7	151	153 max.
Max. " " boilers, "	155.5	155.5	155	151	155.5	....
Steam press. M. P. rec. "	0	8	26.5	41.75	45	43
" " L. P. " in. vac.	13.1	11.5	1.85	2.75 lbs.	3.4 lbs.	6 1 lbs.
Circulating pump rev.	180	202	220	360	400	400
Feed pump double stroke. .	14.6	18.4	18	23	25	28.5
Temp. of hot well, deg. Fah.	61	62 5	111.5	117	122	112 to 136 average 125
" overb'd discharge....	67	75	91	88	96	80 to 98 average 86
" sea water, Fah.	48	48.5	48.5	48	48	48.5
" engine room, Fah	80	80	79.5	80	83	84. 5 to 87
" fire room, Fah..... .	99	98	98.5	97	110	98 to 108
Revolutions per minute	48.4	76.16	103.5	120	125	131.5
I. H. P. of H. P. cylinder.....	36.5	109	228	318	357	276
" " I. P. "	27.2	81.19	214	337	389	530
" " L. P. " ,.....	19.2	51.29	143.5	252	290	431
M. E. P. H. P. cylinder.....	19.5	37.22	57.1	68.8	74.2	54.3
" I. P. "	6.0	11.45	22.17	30.1	33 35	43 2
" L. P. "	1.6	2.8	5.73	8.78	9.62	13.6
M. E. P. referred to L. P. Cyl.	7.2	13 5	24.01	32.24	35.30	40.17
Total I. H. P.....	82.9	241.48	585.5	907	1,036	1,237
Avge. I. H. P. for entire run .	82.9	241.5	585.5	907	1,100	1,150
Speed, knots	4.54	7.1	9.95	11.85	12.9	13.15

EXPERIMENTAL ELECTRIC LAUNCH.—II.*

BY PROF. OSWALD FLAMM.

(Continued from page 342, July, 1902.)

The boat was given the usual form of modern torpedo-boat stern. Following is the schedule of weights:

Hull and deck house ..... 5.944 tons.
Stern tube, shaft, and propeller.... .207 "
Motive power equipment..... 11.049 "

Having reference to the power trials to be presently described, the weight of machinery equipment was about 408 pounds per horse power. This is admittedly an excessive value and leads us to look for an effort, and we may hope an effective effort, on the part of the electrical engineer to reduce such weights to lower values. In reference to the electrical equipment it should be said that the entire battery was of the so-called "dry cell" type, a form of cell which for marine work has the advantage that in the heaviest sea, and no matter what the motion of the boat, the performance of the battery is the same. In order to conduce to lightness of motor the revolutions of the shaft at full power were taken as not less than one thousand per minute.

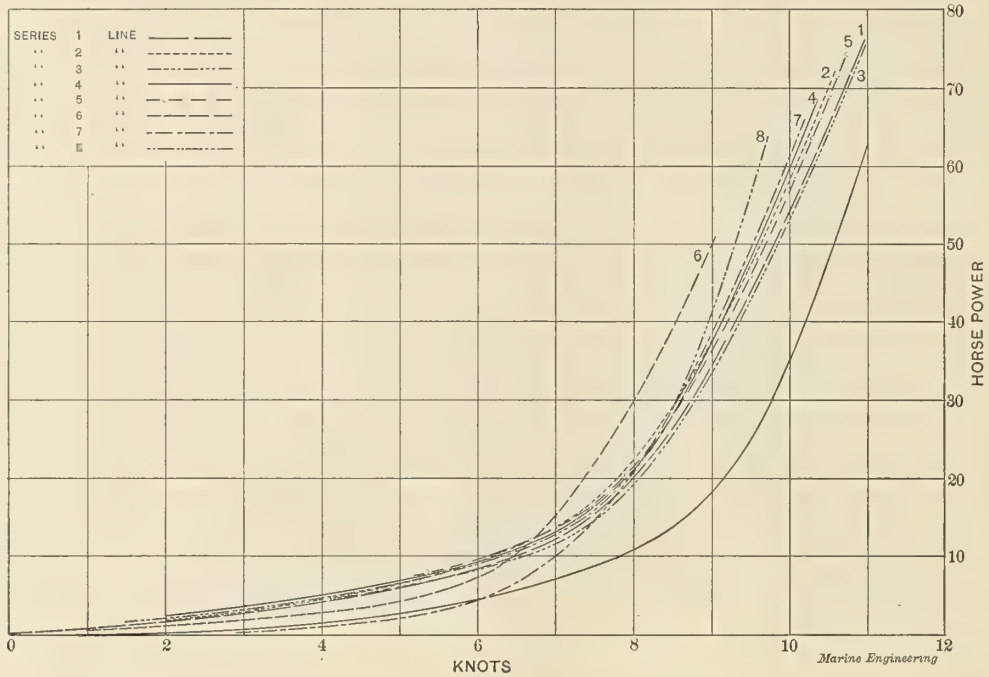


FIG. 6.

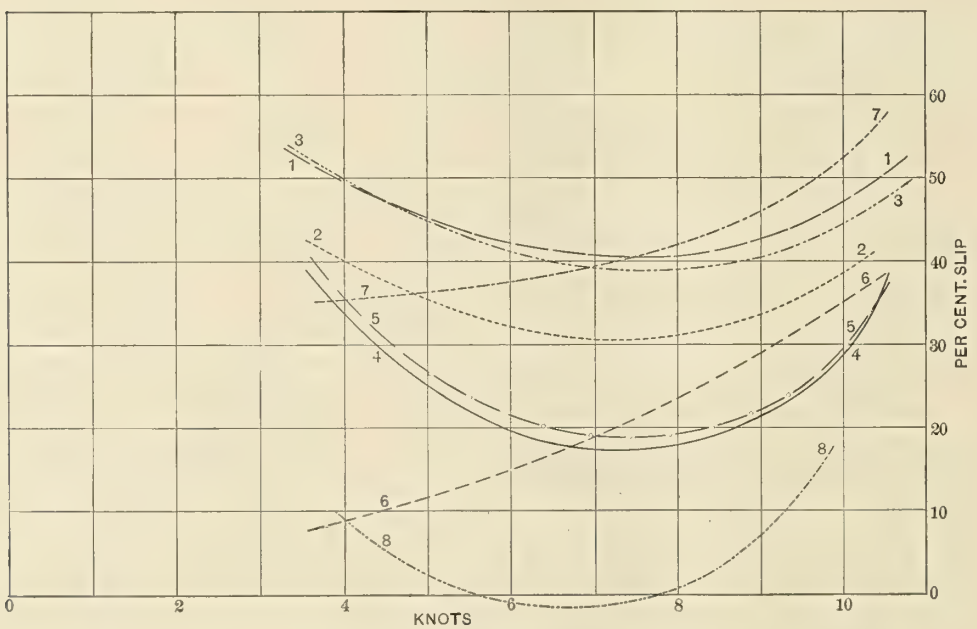


FIG. 7.

*Translated from *Schiffbau*, February 23, 1902.

Two propellers were fitted on the shaft, one aft of the other, and determinations were made regarding the dimensions and working relations of the propellers. The controller arrangement provided for three grades of power and speed. In order to reduce friction losses as much as possible, the thrust bearing was made of the ball-bearing form, and to provide for the elasticity of the boat the nickel-steel line shaft was coupled to the motor shaft with a universal coupling, an arrangement which proved very satisfactory in the trials of the boat.

Number.	Diameter.	Pitch.	Projected Area.
1.....	1.48.....	1.64.....	.39
2.....	1.48.....	1.64.....	.59
3.....	1.44.....	1 17.....	.59
4.....	1.48	1.71.....	.50
5.....	1 77.....	1.17.....	.12

In the accompanying figures are shown curves of horse power, slip, and revolutions for these various propellers. Of especial note is the wide range of slip and

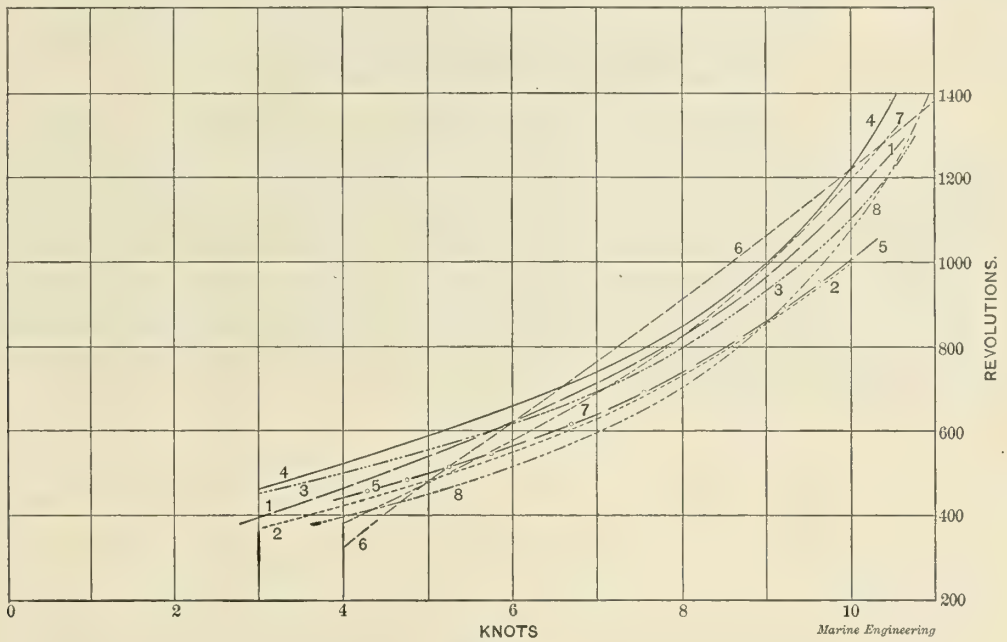


FIG. 8.

In September, 1901, the boat was placed in the water and after a short trial on the Havel went with her own power to Stettin and then to Swinemünde. There trials were carried out, and in stormy weather, which showed the seaworthiness of the boat in a very gratifying manner. The speeds reached on these trials were not such as to warrant any general conclusions. The two propellers fitted were of the following dimensions:

Diameter..... 1.48 ft.
Pitch ..... 1.64 "
Projected Area..... .39 sq. ft.

In order to investigate the influence of the projected area of the propeller blades, a second pair of like construction was fitted of the following dimensions:

Diameter..... 1.48 ft.
Pitch ..... 1.64 "
Projected Area ..... .59 sq ft.

The entire series of tests indicated that these propellers should give somewhat better results than those first fitted. Regular and complete tests, however, were not carried out till November on the Tegeler See. In these tests the speed was not taken over a measured mile, but by three carefully rated patent logs. The speeds of Table II. relate solely to the indications of these logs. In connection with the later trials, extended tests of propellers were made of the following dimensions:

the especially low values to which it was reduced in certain cases. These, however, gave an uneconomical result. Note may also be made of the performance of the large propeller, whose area was equal to that of the two small ones. In the results there often appeared together higher slip and lower horse power with greater speed. The highest speed reached lay in the neighborhood of ten knots.

The trials of this boat indicate at least that we may hope, through the further combined efforts of the electrical engineer and the shipbuilder, for further and still more satisfactory developments in electrical boat propulsion.

TABLES I.

SERIES I.

One Propeller, No. 1, aft. Sea smooth.

Speed in Knots.	Wind.	Battery Volts.	Motor Volts.	Amperes.	Horse Power at Motor.	Revolutions.	Slip.
4.48	against	80	76	48	4.96	522	.470
4.58	with	80	76	46	4.75	526	.460
7.50	against	80	76	155	16.	768	.398
7.50	with	80	76	150	15.5	766	.398
7.50	against	157	75.5	75	15.4	780	.408
7.42	with	156	75.5	75	15.4	770	.408
9.78	against	149	144	258	50.5	1105	.453
9.74	with	148	143	254	49.4	1105	.457

Series 2.

Two Propellers, No. 1.

Speed in Knots.	Wind.	Battery Volts.	Motor Volts.	Amperes.	Horse Power at Motor.	Revolutions.	Slip.
5.22	with	81	78	50	5.03	477	.324
4.52	against	82	78	53	5.62	461	.395
7.62	against	80	76	177	18.25	688	.317
7.66	with	80	76	177	18.25	695	.319
7.88	with	157	152	87	17.95	695	.298
7.74	against	158	152	90	18.60	692	.308
10.12	with	150	144	302	59.00	1010	.382
9.94	against	151	144	305	59.60	1020	.400

Series 3.

One Propeller, No. 2. Sea smooth.

Speed in Knots.	Wind.	Battery Volts.	Motor Volts.	Amperes.	Horse Power at Motor.	Revolutions.	Slip.
3.96	against	82	78	48	5.08	508	.520
4.48	with	81	78	50	5.30	510	.458
7.62	against	81	77	162	16.95	758	.400
7.48	with	81	77	158	16.50	762	.395
7.60	against	158	152	76	15.70	760	.390
7.60	with	158	152	76	15.70	753	.383
9.88	against	149	144	265	51.80	1095	.444
9.88	with	150	144	265	51.80	1088	.440

Series 4.

One Propeller, No. 3.

Speed in Knots.	Wind.	Battery Volts.	Motor Volts.	Amperes.	Horse Power at Motor.	Revolutions.	Slip.
4.14	.....	82	80	50	5.44	520	.313
7.54	.....	82	78	152	16.10	782	.165
7.54	....	161	156	72.5	15.35	780	.164
9.60	.....	154	147	265	51.00	1138	.265

Series 5.

Two Propellers. Forward No. 3, Aft No. 2.

Speed in Knots.	Wind.	Battery Volts.	Motor Volts.	Amperes.	Horse Power at Motor.	Revolutions.	Slip.
3.82	against	81	38	55	5.67	457	.40
4.84	with	80	38	55	5.67	480	.27
7.74	against	80	76	177	18.25	686	.19
7.74	with	79	76	173	17.85	690	.19
7.74	against	157	75.5	85	17.40	686	.17
7.54	with	157	75.5	82	16.85	690	.22
9.88	against	146	139	293	55.30	1000	.29
9.88	with	146	139	290	54.75	995	.28

Series 6.

One Propeller, No. 3, forward. Sea rough.

Speed in Knots.	Wind.	Battery Volts.	Motor Volts.	Amperes.	Horse Power at Motor.	Revolutions.	Slip.
5.12	against	83	39	44	4.66	508	.15
5.36	with	82	39	47	4.98	513	.10
6.90	against	81	76	154	15.90	756	.21
7.20	with	80	76	152	15.70	762	.18
8.62	against	151	140	214	40.70	1005	.26
8.74	with	146	139	211	39.80	1000	.26
8.67	against	142	135	260	47.70	1070	.30
8.80	with	140	133	257	46.40	1062	.28

Series 7.

One Propeller, No. 4, aft. Light wind.

Speed in Knots.	Wind.	Battery Volts.	Motor Volts.	Amperes.	Horse Power at Motor.	Revolutions.	Slip.
9.63	with	154.5	146	255	50.6	1110	.962
9.20	against	150.5	142	251	48.5	1110	.962
9 22	against	150	142	215	41.5	1018	.882
7.65	with	156	150	70	14.25	757	.656
7.38	against	80	75	149	15.20	757	.656
5.58	with	80	38	43	2.22	528	.458

Series 8.

One Propeller, No. 5, aft. Rough water.

Speed in Knots.	Wind.	Battery Volts.	Motor Volts.	Amperes.	Horse-Power at Motor.	Revolutions.	Slip.
4.56	against	80	78	58	6.15	443	.107
5.22	with	82	78	54	5.72	447	.0002
7.88	against	80	77	186	19.45	668	.0002
7.74	with	80	77	183	19.15	670	.000
7.98	against	156	152	92	19.00	675	.00025
7.74	with	156	150	91	18.60	677	.01
9.60	against	148	140	315	59.98	984	.153
9.60	with	147	140	312	59.20	970	.143

TABLE II.

Economic Results.

Speed in Knots.	Horse Power.	Watts.	Radius of Action in Hours.	Radius of Action in Miles.	Expense per Trip.			Horse Power Hours.	Cost per Horse Power Hour in Marks.	Cost per Hour in Marks.
					Watts.	Kilowatt Hours.	Cost in Marks.			
10.00	59.30	43600	3	30	66500	200	20.00	178	.112	6.64
7.70	18.10	13450	13	100	19500	254	25.40	234	.109	1.97
4.90	5.30	4060	45	220	5660	254	25.40	238	.107	.57

Shamrock III.—Sir Thomas Lipton is building a third challenger for the America's cup, to be called *Shamrock III.* The yacht, which is to be of sloop rig, has been designed by Mr. William Fife, in consultation with Mr. Watson, the designer of the former *Shamrocks.*

Fuel Oil on the Pacific.—It is stated that over sixty steam vessels sailing from and about the bay of San Francisco are using crude oil exclusively for fuel. This number includes small tugs, river boats, ferryboats, coasting steamers, and transpacific ships.

Barges for Manila.—A fleet of steel barges for use in Manila harbor, for lightering freight between the shore and steamers in the port, is now in active service. The fleet includes nineteen barges in all, six of which are steam. The vessels are owned by the Philippine Transportation and Construction Company, and it is expected that their use will greatly reduce the cost and facilitate the handling of freight in the Philippines. The barges were built in Cleveland, O., and shipped from New York on the decks of large freighters.

THE STEAMER MIRA ASHORE ON CHEBOGUE POINT, NOVA SCOTIA.

A REMARKABLE CASE OF SALVING.

BY PROF. ALEX. J. MACLEAN.

The steel steamer *Mira,* having molded dimensions 350 feet by 46 feet 1-2 inch by 30 feet 1 inch, net tonnage 2,409 and gross tonnage 3,779, was built at Messrs. Swan and Hunter's shipyard at Wallsend-on-Tyne, England, in June, 1901. She was owned by the Dominion and Atlantic Coal Company, of Cape Breton Island, and classed 100 A1 at Lloyds.

The ship was especially designed as a collier, having a single set of triple-expansion engines right aft, capable of driving her at a speed of 10 knots per hour when fully loaded. There are large hatches, 19 by 16 feet, the sides of which are formed by continuous vertical plates running right fore and aft on the steel-plated deck, thus forming a strong longitudinal girder. One large hold box beam, midway between main water-tight bulkheads, supported in the center with an I stanchion and on each side of the same a circular stanchion, takes the place of web frames. The double bottom, 4 feet deep, with a capacity of 1,073 tons, has an inclined margin plate running from the flat of inner bottom to the upper turn of bilge, and is pierced by the channel frames and made water-tight with shoeing. This system of margin plate gives more capacity to the double bottom and allows cargo in bulk, such as coal, to slide down to the flat of inner bottom. There is also a large, deep tank amidships for 1,415 tons of water ballast or for cargo, the transverse bulkheads of which are well stiffened with wide fore-and-aft webs on the center line. All water-tight bulkheads are stiffened on one side only by channel bars. The bunkers, situated abreast the engine room and running up to the poop deck, have a total capacity of 262 tons.

The light draft of the *Mira,* no coal or fresh water on board, and boilers empty, is 4 feet forward and 14 feet aft, and on a mean load draft of 23 1-2 feet she carries a little over 6,000 tons dead weight. Her general fittings, such as winches, windlass, electric lighting, etc., are above the average for this class of vessel.

The *Mira* left Boston, Mass., on February 1, 1902, bound to Louisburg, Cape Breton Island, partially loaded with timber and machinery, having a crew of thirty-four men, all told. She at first met light easterly winds, but toward midnight a gale sprang up from E.S.E. with a heavy sea running and accompanied by snow squalls. The ship was steaming five knots an hour. These conditions prevailed when, at 1:45 A.M. of the 3d, a light was seen a little off the port bow. The master, being called, decided that it was Cape Sable Island light, and gave orders to steer directly away from the light and to increase the speed to ten knots an hour. The second mate, who was standing that watch, at 3:10 A.M. saw breakers ahead. He reversed the engine at full speed and ported his helm, but too late to prevent the ship stranding. The engines were kept working astern until the rudder post, fouling some rocks, broke, carrying with it the rudder, which struck the blades of the propeller and broke them off short. Then the engine was stopped.

Daylight revealed the fact that they were high and dry on Chebogue Point, Nova Scotia, lying parallel with the shore. The master had mistaken Cape Forchu light for that on Cape Sable Island, the two being similar in every respect. The crew saved their effects, and the ship was reported a total wreck. Mr. Eakin, the Lloyds' agent at Yarmouth, Nova Scotia, the nearest town to Chebogue Point, nine miles distant, then took charge of her and salved the cargo. Tenders for wrecking the steamer being asked for, that of Captain Reid,

of Sarnia, Ontario, was accepted. He contracted to deliver the ship at a dock either at Boston or Halifax for $50,000.

her afloat in a thick fog on Saturday night, August 2, but only succeeded in pulling her astern about 60 feet, and her stern out from the shore 30 feet, when

THE MIRA AT LOW TIDE, SHOWING THE LEDGE ON WHICH SHE STRANDED.

On surveying the hull it was found that not only had the rudder frame, rudder, and propeller blades been carried away, but the outer bottom was badly damaged, especially abreast No. 2 hold, where the center vertical keel, with the I stanchion above it, was bent up. All the seams and butts in way of the double bottom, both inside and out, were so severely strained that numerous rivets fell out.

There being large rocks abreast the ship fore and aft on the off-shore side, and the ship working badly as she lay, Captain Reid adopted the plan of digging a trench 400 feet long, 60 feet broad, and 4 feet deep on the in-shore side of the ship, and clearing away large ledges of rocks aft of the trench, then pushing the ship into this basin and floating her out stern first.

About the first of May he commenced to blast out with dynamite the slaty rock, which runs in vertical strata at this point, and, at the same time, with the use of an air compressor, calked the leaky seams and made temporary repairs along the outer and inner bottoms. The ship was kept steady at high water by building stone cribs under her bilges and allowing the water to rise inside of the hull. The trench being completed, steel-wire ropes attached to rocks in-shore were led to the winches on board, and four 100-ton hydraulic jacks were placed against the hull on the off-shore side. By these means she was hauled, on July 31, into the trench.

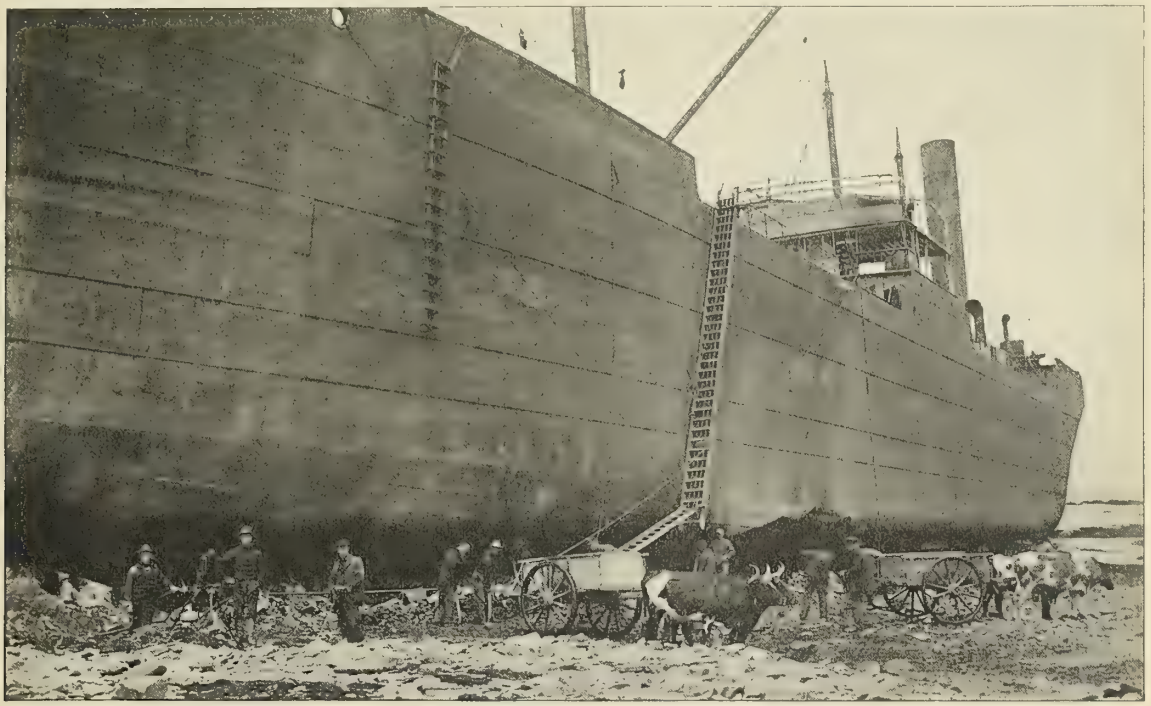
Braced wooden shores were substituted for the three stone cribs, and three extra pumps were put on board to be used with the ship's pumps in clearing the hold. When all was in readiness, with the aid of the deep-sea tug *Flushing*, Captain Reid made an attempt to get

she fouled the rock at the outside of the trench. This rock was cleared away. Then one end of a steel-wire

BROKEN STERN FRAME, RUDDER, AND PROPELLER.

hawser was made fast to a rock 100 yards right aft on the in-shore side, and the other attached to a fall leading to one of the ship's steam winches. The starboard an-

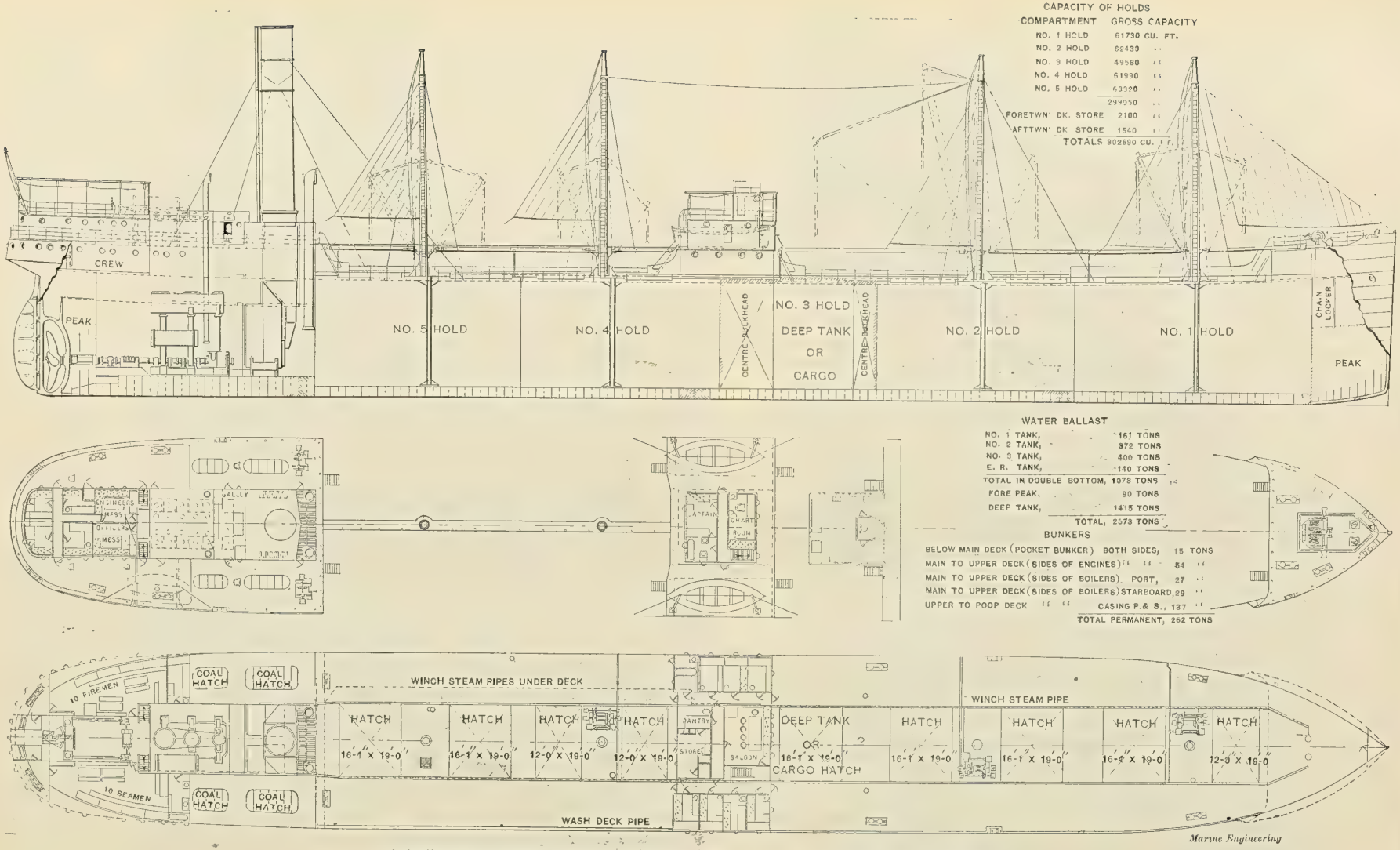
chor was placed on the off-shore or starboard side, amidships, in a hole dug in the rocks to receive the flukes, and had a pull from the windlass. With the aid of the tug, another attempt to float the ship was made the next night, but was unsuccessful. More rock had to be blasted away from under her after bilges. It being noticed that she had a list to port during these trials, the cast-steel rudder post and rudder were picked up and placed on the starboard side, and the large hole in the bottom was stopped up with a cotton and canvas mat.



BLASTING AWAY THE ROCK ON THE IN-SHORE SIDE.

TRENCH FORMED ON IN-SHORE SIDE OF SHIP, INTO WHICH SHE WAS LAUNCHED.

The last and successful attempt was made on Wednesday night, the 20th of August. On this occasion the



ELEVATION AND DECK PLANS OF STEAMSHIP MIRA, BUILT BY SWAN AND HUNTER.

starboard anchor was taken 600 feet off-shore amidships. With the assistance of two small tugs from Yarmouth, her stern was pulled out, pivoting about her stern frame until she was at right angles with the shore line, when she slid off entirely, and, amid the whistles of the steamers and shouts from onlookers on shore, made her way without accident to the town of Yarmouth, from which harbor she has been towed to Halifax and there sold.

ELECTRIC IGNITION.—III.

BY DONALD M. BLISS.

The chief characteristic of a well-designed dynamo igniter is its greater output when compared with the magneto type, as stated in a previous paper. The only essential difference between the direct-current magneto and the dynamo is the manner by which the magnetic field is obtained.

In the magneto, permanent steel magnets are used: in the dynamo type the magnetic field is secured by powerful electric magnets composed of a soft-iron core and surrounded by a winding of insulated copper wire through which the current producing the magnetism flows. As this current is derived from the armature, it is evident that when the dynamo is not running there can be no current flowing and therefore no magnetism is produced.

A number of ingenious devices operating automatic clutch pulleys have been designed to secure this desirable result, and as dynamo igniters are quite largely used it may be of interest to describe one of the machines of this class:

One of the best known machines is the auto-sparker as in Fig. 1, which illustrates clearly the automatic device for securing a constant armature speed, though the speed of the engine driving the dynamo may vary through wide limits. The dynamo is fitted at its commutator end with a governor operating a rod which runs through the machine from end to end. When the speed of the shaft reaches the standard for which it is adjusted, the governor weights fly out, pushing the steel sleeve (6) out against the steel plate (5). This plate is mounted on one end of a lever pivoted at (9). This movement of the governor weights causes the other end of the lever at (7) to rise, and as this lever is connected to the body of the machine at (16), it raises that side of the dynamo up, since the entire machine is pivoted in its supporting frame at point (1). The dynamo pulley is in contact with the flywheel of the engine just above the point (10). It is this action of the governor which causes the pulley end to recede from the flywheel, thus reducing the speed, so that the action between the governor and spring serves to keep the armature running at a fairly constant speed, regardless of the diameter of the flywheel or variation in speed of the engine. The spring (12), which serves the double purpose of forcing the friction pulley against the flywheel and acting as a tension on the governor, may be adjusted by the thumbscrew (12).

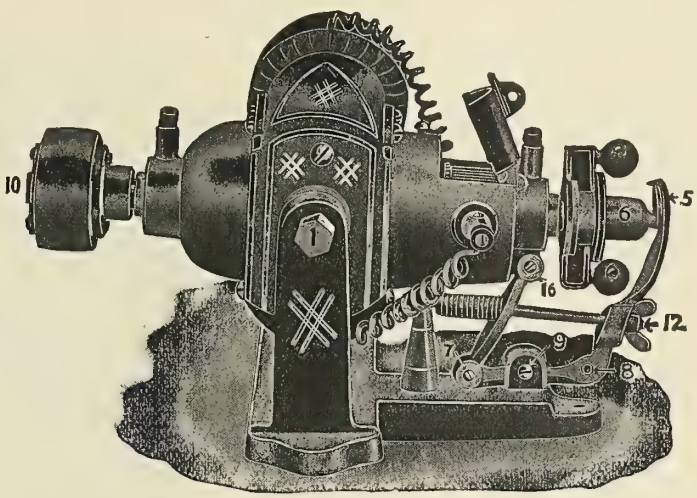


FIG. 1.

The magnetizing coil or field winding is permanently connected to the brush-holder terminals, so that whether the dynamo is supplying any current outside of itself or not, the field is kept magnetized as long as the armature is running at its proper speed. This arrangement is known as a shunt connection. In some cases an additional winding is wound on the field magnets, through which all the current generated by the armature flows. This is known as a compound winding and is well adapted for sparking dynamos.

For a given weight, an electro magnet can be made, which is much stronger than a permanent steel magnet—hence the greater output of the dynamo type. A magneto igniter weighing from 20 to 25 pounds may not deliver more than 2 amperes at 10 volts pressure, while a dynamo igniter of equal weight may easily give 6 amperes at 10 volts, or three times the output of the former.

A dynamo, whether shunt or compound wound, must be run at a fairly constant speed; for if the speed be much lower than the standard for which it is designed, the current and resulting magnetism will be so feeble that satisfactory sparks cannot be obtained. If run at a high speed so much current will be taken by the shunt coils that over-heating or even burn-outs may result.

By tightening or loosening this screw the speed of the auto-sparker may be increased or reduced, which in turn increases or diminishes the current and therefore the size of the spark.

The action of the governor may be reversed, if desirable, so as to raise the pulley up instead of down in cases where it is necessary to use the machine on top of a flywheel. This arrangement prevents any possibility of burn-out, and if the moving parts are kept

clean and receive ordinary attention this dynamo will give good service.

In a friction drive of this kind where frequent intermittent contact is maintained between the driving and the driven pulley, a rubber friction pulley is not desirable. Such a pulley should be made of the best compressed fibre.

Referring once more to the subject of brushes and commutators, it is even more essential to maintain absolute cleanliness and freedom from oil with the dynamo sparker than with the magneto, for in starting up the dynamo, where the initial magnetism is extremely weak, a very feeble current is generated during the first few hundred revolutions of the armature. A slight film of oil or dust on the commutator and brushes in such a case frequently offers so large a resistance that sufficient current to magnetize the field will not be produced. The brushes should be frequently examined and removed from the holder for cleaning.

Fig. 2 shows a new form of sparking dynamo designed by the writer, in which the necessity of an automatic speed-controlling device is overcome. This dynamo is not shunt wound, but has a single winding in the field through which the entire armature current flows. This is known as a series connection, and the wire composing the winding is sufficiently heavy so that it will carry a large variation in current without over-heating. To prevent the current leaving the field when the sparking contacts are separated, which would happen with an ordinary series-wound dynamo, a simple automatic switch enclosed in a water-proof iron case is connected to the dynamo in such a manner that when the sparking contacts are separated the dynamo current flows through a resistance coil, so that the current in the field is never broken. As soon as the contacts go together this auxiliary circuit is opened. No adjustment in the automatic switch is required or provided for, as its effective action depends entirely on the movement of the contacts in the engine cylinder. This dynamo will give a satisfactory sparking current at speeds ranging from 800 to 2,500 R. P. M. An ordinary friction pulley or belt drive may be used.

The dynamo is enclosed and dust-proof. The cap or cover over the commutator and brushes may be instantly removed, thus giving complete access to the working parts for cleaning and inspection without interfering with the running of the machine. The two dynamos here shown, or others of similar design and capacity, generate sufficient current to operate jump-spark coils with satisfactory results. The output of these machines may be as high as 6 amperes at 10 volts pressure at 1,800 to 2,000 R. P. M., so that when storage cells are used as an auxiliary for starting the engine these machines will easily give sufficient current for charging purposes.

In selecting a dynamo or magneto the following important requirements for securing satisfaction should be kept in mind:

The armatures, commutators, and brushes should be completely enclosed and water-proof; at the same time means should be provided for removing the covers, so as to give perfect access to its parts for cleaning and examination without stopping the dynamo or interfering with its operation.

The armature shaft should be of best grade of steel, and at least 3-8 or 1-2 inch in diameter at the pulley end to prevent springing or bending under excessive pressure.

The combination carbon and copper brush is preferable to the all-copper brush, for the reasons given in a previous paper, and these brushes should be of ample size and cover the commutator sufficiently to prevent any tendency to spark in ordinary working conditions. Machines having small, round pencil brushes, fitting loosely in a tube holder in such a manner that the brushes cannot be removed without stopping the machine, will not be found satisfactory.

Owing to the liability of moisture and corrosion, fibre or rubber insulation for the brush-carrying parts are not desirable. Mica insulation of sufficient thickness should be used.

The brush holder should be so arranged that the brush may be fed with a uniform pressure and good contact until it is practically worn out, and this feeding should be accomplished without changing the position of the brush on the commutator.

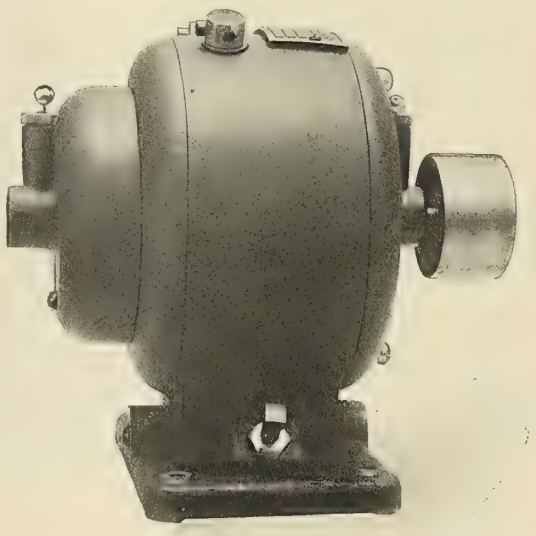


FIG. 2.

The armature bearings should be of the best phosphor-bronze or other equally good wearing material, and the means of lubrication, whether oil or grease is used, should be so arranged that there is no failure to feed so long as any lubricant is left in the cups. Many machines are defective in having no means for preventing the creeping of oil to the commutator and brushes. Such a condition will speedily result in destroying the good contact with the commutator and render failures of frequent occurrence.

In conclusion it may be stated that a thoroughly satisfactory igniting dynamo or magneto cannot be built or sold for a low price, and when an engine costing hundreds of dollars is put in commission it is poor policy to consider the matter of a few dollars in the selection of the igniter, upon which the satisfactory performance of the engine so largely depends.

THE NEED OF AN AMERICAN ISTHMIAN CANAL.

BY W. J. MANSON, ESQ.

The Pacific coast opponents of an Isthmian canal often urge as an argument that the remote isolation of the Pacific coast is an element of advantage in its favor, and that the construction of such canal will prove injurious to its many and varied industries. When it is remembered that railroads cannot and will not carry the heavy, cheap, and bulky productions of that prolific region, and that those productions must reach centers of population and of business at lowest rates of freight in order to leave any margin of profit to producers, this argument of the opponents to the canalization of the American Isthmus might be considered as sufficiently answered.

Not only do the great agricultural, lumbering, mining, quarrying, and fishing interests of that coast imperatively demand the early construction of such water highway of commerce, but for the manufacturing and shipbuilding interests of the Pacific coast such canal is an admitted necessity. The chief retardment to the shipbuilding interests of the Pacific coast, according to Mr. Geo. W. Dickie, of the Union Iron Works, in his article in the *Overland Monthly*, July, 1902, on the Building of Battleships, is "its remoteness from centers where the raw materials are produced, most of which must be transported 3,000 miles by rail or 14,000 miles by water."

That the Pacific coast offers many great advantages (not the least of which is its splendid working climate) for vast manufacturing enterprises will not be denied. When the raw material, those essentials, good coal and iron, can be laid down cheaply and expeditiously and without twice crossing the Equator upon a long, tempestuous, and dangerous voyage, the essential difficulty that has retarded the growth of Pacific coast manufactures of every class will be overcome, and mechanical operations of vast magnitude may be relied upon to give steady employment to a large and varied force of skilled artisans and mechanics

While an Isthmian canal will render our union closer and more permanent, and while this immediate and, as it may be termed, domestic advantage cannot be overestimated, yet from a strictly commercial standpoint such canal finds a greater argument for its construction in that it will bring the large centers of business and of population of the United States, where are concentrated its greatest energies, in close and cheap water communication with the Orient. Notwithstanding the fact that San Francisco is 9,000 miles nearer to Japan and China than is London, its share is inconsiderable in the vast foreign trade of those opulent countries. The centers of population and of industrial energy of America must be brought in close water communication with the Orient, in order that America may harvest her fair proportion of Oriental trade.

In 1894 the total foreign trade of China, Japan, Korea, and Siam aggregated $725,000,000 (silver). The share of China and Japan was $565,000,000, and in both China and Japan their imports exceeded their exports. In 1894 Japan imported from the United States $11,000,000 of merchandise, and in the same year Japan exported to the United States $43,000,000 of merchandise, or a balance *against us* of $32,000,000. In 1894 England bought from Japan $6,000,000 of merchandise and sold to Japan $42,000,000 of merchandise, a balance in England's favor of $36,000,000.

An examination of the trade relations of China with England and of China with America will tell the same story of American opportunity neglected.

But look for a moment at the decadence and wellnigh extinction of American shipping interests in Oriental ports teeming with an opulent foreign commerce. The story is best told by Hon. John M. Barrett, U. S. Minister to Siam, in his article in the *North American Review*, vol. 162, page 257:

"Shanghai is the most important port of China. In 1894, 2,844 merchant steamers, with a tonnage of 3,304,918, entered this port, but not one was American! Not one American trading steamer came to New Chwang out of 348; not one to Tientsin out of 645; not one to Chefoo out of 1,031; not one to Chinkiang out of 1,493; not one to Foochow out of 294; not one to Canton out of 2,250. Kind Amoy only breaks the mournful record, where four lone steamers out of 822 found a haven in her quiet waters. Hong-Kong, of course, is the terminal point of our few transpacific steamer lines, but that is not strictly a Chinese port."

If American shipping interests, if American mercantile interests, are to be put upon the soundest business basis; if America's mighty energies are to be placed where they can compete for this great industrial and commercial prize—Oriental trade—which has brought opulence to European countries not nearly so advantageously situated with reference to the Orient as America will be when we build and own an Isthmian canal; if the doctrine of the survival of the fittest is applicable to nations, then must America unite with a ship canal the oceans which embrace her coasts and keep the connecting waters bright with her passing keels.

The considerations of national unity and national defense are so potent, have been so frequently urged, and seem now to be so fully understood, that it should not be necessary to say anything upon these points, except, perhaps, that while America is so situated that she is the least likely of the nations of the earth to be engaged in war, yet, since in time of war America's possession of such canal is a strategic advantage in her favor, the canal itself will become the point and object of attack and is liable, notwithstanding treaties, to fall into the possession of that power which has the strongest navy. America, then, owes it to herself, to her trade extension, to her rightful dominance of the trade of the two great oceans embracing her coasts (which is certain and in the near future), to create and maintain a navy which in size and number of vessels, equipment, and armament shall be the most powerful in the world.

Now, briefly, as to the selection of a canal route. Until within a year or two past the only canal project before the American people was the Nicaragua project. The Panama canal has been exclusively in the hands of French concessionaires, and neither the American press nor the public has given to it the consideration which it deserves. Under these circumstances the in-

terest and sympathy of the American public in the Nicaragua enterprise was natural and to be expected.

The recent unanimous report of the Isthmian Canal Commission, commonly called the Walker Report, in favor of the Panama route has called to that route the critical attention of the public. This attention has been quickened, rather than diminished, by the recent legislation of Congress in passing what is known as the Spooner Amendment, by the terms of which the President of the United States is authorized to acquire, on behalf of the United States, for a sum not exceeding $40,000,000, all the property rights of every name and nature held by the New Panama Canal Company on the Isthmus, including the Panama Railroad, provided a satisfactory title is obtainable. If title to the Panama properties cannot be obtained within a reasonable time, the President is authorized to obtain by treaty with Costa Rica and Nicaragua perpetual control, on behalf of the United States, of the requisite strip of territory for the construction of a ship canal by way of what is known as the Nicaragua route.

The advantage which the Isthmian Canal Commission and Congress deem the Panama canal enterprise to possess over the Nicaragua project may be briefly summarized as follows:

1. The Panama canal is shorter, being only 49 miles as against 183 miles by way of Nicaragua.

2. The annual cost of maintenance of the Panama canal is $1,350,000 less than the annual cost of maintenance of the Nicaragua canal. This is an annual outlay. It represents, at Government rates, the interest on $65,000,000.

3. The waters of the Caribbean Sea in the vicinity of Greytown (the Atlantic terminus of the Nicaragua canal) are, during much of the year, rough and dangerous to shipping, and the weather tempestuous. Weather conditions and shore currents are believed to be more favorable to shipping in the vicinity of Colon.

4. Over 70 per cent. of the length of the Nicaragua canal, constituting the high level, is at an elevation of 110 feet above the level of the oceans. The water in this high level is retained by miles of high embankments. This long, high level is inherently dangerous in a country liable to the heaviest of tropical rains, and subject, on the east side of the lake, to an annual rainfall of between 300 and 400 inches. On the other hand, the Panama canal is susceptible of being made a sea-level canal, though the present plans for that structure contemplate a short, high level about 20 miles in length, at an elevation of about 89 feet above sea level. The average annual rainfall at Panama is about 130 inches. On the Nicaragua canal the ascent to the high level is made by four locks on the Atlantic side and four on the Pacific side, or eight locks in all. On the Panama canal the ascent to the high level is made by two locks on the Atlantic side and three on the Pacific side, or five in all.

5. The cost of completing the Panama canal is placed by the Commission at $144,233,358, to which sum must be added the cost of the Colombian concessions to the United States, probably $7,000,000, and the price to be paid the French companies, $40,000,000.

The cost of constructing the Nicaragua canal is estimated by the Commission at $189,764,062, to which sum must be added the cost of concessions from Nicaragua and Costa Rica, and the acquisition of the right of way by our Government from private parties in possession.

6. The Panama route traverses a country well understood and thoroughly mapped. No unknown difficulties are involved. The engineering problems which arise are known, and none of them are doubtful or difficult, except, perhaps, the dam at Bohio. The Nicaragua route passes through an unsettled and undeveloped wilderness. Engineers are uncertain as to many of the problems presented, and the estimated cost will be considered by conservative men as only an intelligent guess.

7. The Panama route possesses fair harbors at both termini. None exists at Nicaragua, and the construction of a harbor at the Atlantic terminus of the canal is a difficult and involved problem.

8. The Panama route possesses a modern and well-equipped railroad following closely the line of the canal. This greatly facilitates the work of construction, to say nothing of its being a source of revenue.

9. The Commission seems to consider climatic conditions somewhat worse at Panama, though the differences are slight. Efficient sanitary supervision of camps, an adequate sewerage system, a good water supply, are indispensable hygienic precautions which will greatly improve health conditions along either route.

10. The curvature of the Nicaragua route is excessive as to the total number of degrees of curvature, the number of miles of curvature, and the sharpness of the proposed curves. When we consider that during at least half of the year a strong breeze of 16 knots blows here across the Isthmus, and athwart the proposed canal at various points, it can be seen that navigation of the canal would be seriously impaired. In the opinion of the most informed and practical navigators, such as Captain Watt, of the *Campania;* Captain Cameron, of the *Oceanic;* Captain Jamison, of the *St. Paul;* Captain Richter, of the *Kronprins Wilhelm;* Captain Hoegemann, of the *Kaiser Wilhelm der Grosse,* and numerous others equally competent to speak upon this point, an average-size steamer, say 450 feet in length and drawing 25 feet of water, could not pass through the Nicaragua canal with her own steam, but would require from two to five tugs. Considering the curvature, the breeze, and the width of the canal, these practical navigators, who have navigated the Suez, the Manchester, and other canals, say that were the Nicaragua canal built a steamer might get athwart the canal, with her bow on one bank and her stern on the other, blocking traffic indefinitely. Each of these captains and practical seamen (some eighty odd in all) says that were both canals constructed, and were he sailing an average-size steamer from New York to San Francisco, he would take the Panama route and he would make at least as good time (most say better time) by that route, though the distance from New York to San Francisco is 435 miles greater by way of Panama than by way of Nicaragua. The absence of winds at Panama is looked upon by these captains as a most favorable circumstance for inland navigation. On the other hand, they say that the prevalence of winds at Nicaragua not only delays inland navigation, both of steamers and sailing vessels, but is an element of considerable danger.

It may be concluded, therefore, from the practical standpoint of navigation and operation of the canal

after it is built, that the Nicaragua canal would be an inadequate device for the passage of sailing vessels or steamers from sea to sea. This point is clearly and convincingly made by Senator Hanna in his speech in the Senate (*Congressional Record*, June 9, 1902, page 6873).

A good deal has been said about the Nicaragua canal being better situated and more practicable for our sailing tonnage, constituting, it is claimed, nearly five-eighths of our total tonnage, than would be the Panama canal. These general statements are based solely upon the prevalence of wind conditions at Nicaragua and calm conditions at Panama. Nicaragua is without, or on the northern edge of, the equatorial calm belt, or the region called by sailors the "doldrums." Panama is well within the region of the "doldrums." It is inferred from these conditions that the Nicaragua route is suited to sailing vessels and the Panama route unsuited to them. From the point of view of practical operation of the canal after it is built, it is apparent that the Nicaragua canal could not be used by sailing ships except at immense expense for towage, and without considerable delay and danger, not only to the ship and cargo, but to all traffic, by reason of such vessel getting athwart the canal and aground on both banks.

The Canal Commission is of the opinion that steamers are now so rapidly replacing sailing vessels that by the time an Isthmian waterway is completed only a very small portion of the tonnage under the flag of the United States will consist of sailing vessels, and the Commission is of the further opinion that sailing vessels will probably be unable to compete with steamers by either route.

This does not mean the elimination of sailing vessels from ocean commerce. The field of their employment will simply be restricted. For portions of our coastwise trade there will always be a demand for sailing vessels.

The effect of the canal upon railroad traffic, particularly transcontinental traffic, is a question to which the writer, for ten years past, has given close consideration. Railroads and canals are supported by the carriage of different species of merchandise. They supplement each other. The carriage of passengers, mails, expressage, quick and light freights, constitutes the natural and legitimate business of the railway. Heavy, cheap, and bulky productions must take the water route (or remain uncarried) in order that some margin of profit may be left to producers.

Do the Great Lakes and the Erie canal impair the efficiency or the dividends of the numerous trunk lines of railway which parallel that splendid waterway? This question need only be asked to answer that those vast systems of railway derive their revenue from the *volume* of the business which that water highway of commerce makes possible, and not from heavy freight charges on those bulky productions which the genius and spirit of the age demand shall be carried cheaply.

An Isthmian canal will enhance the business of railways, even of transcontinental railways. The interior of our country will be inhabited and built up. Where now are barren wastes will be fertile plains and prosperous cities, made prosperous because some margin of profit will be left to producers, and railways will prosper where producers, under a wise and comprehensive legislative policy, are permitted to prosper.

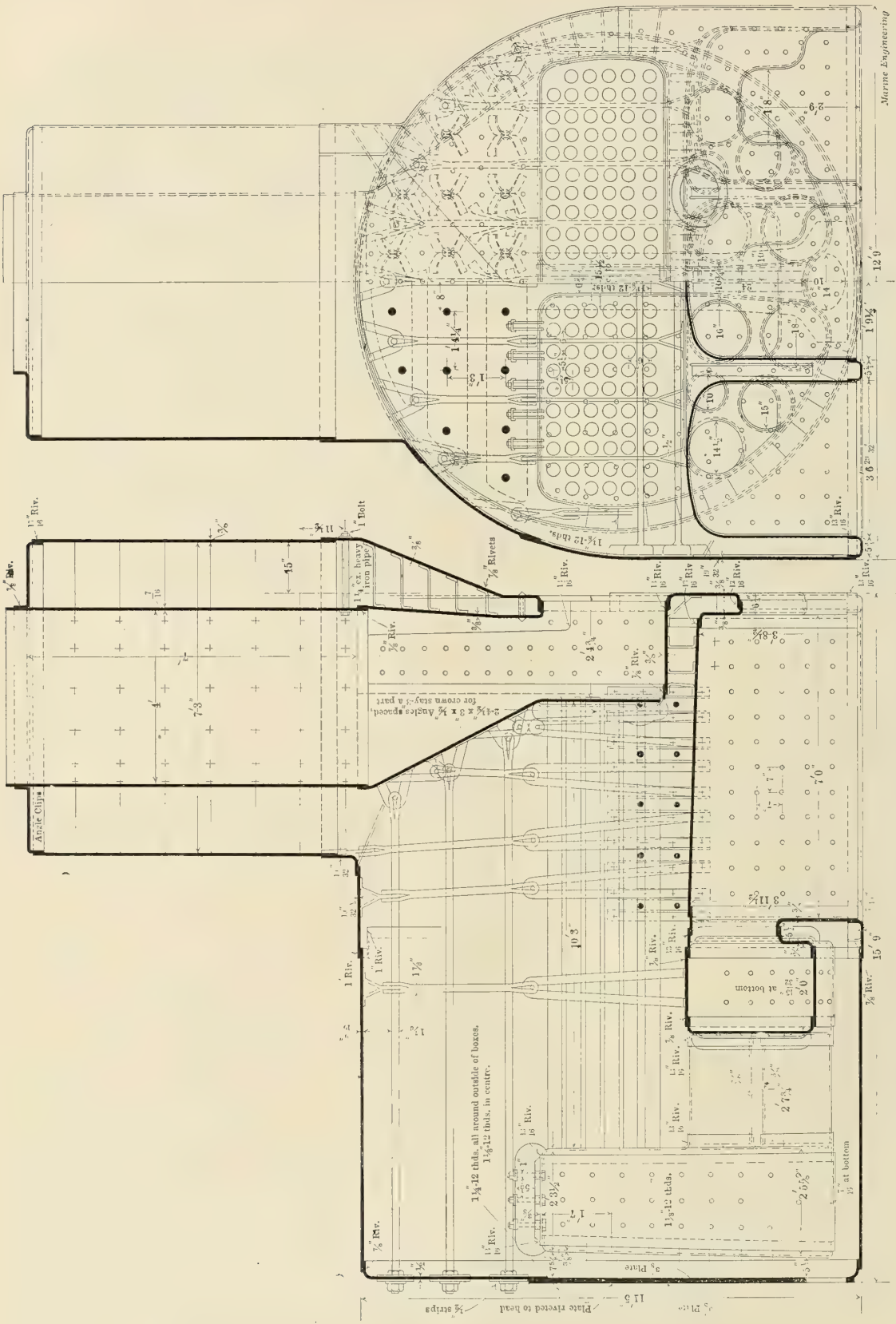
A Modern Flue and Return Tubular Boiler.

In these days of water-tube boilers and Scotch boilers designed for high pressures, a boiler of the old-style flue and return tubular type seems almost a step in a backward direction. The boiler shown in the accompanying engraving has been but recently completed in the boiler shops at the Mare Island Navy Yard and installed on board the U. S. revenue cutter *Perry*. This vessel, although built as late as 1884, is fitted with a simple engine, the cylinder for which is 38 inches in diameter by 40 inches stroke. As the condition of the hull was not such as to warrant the expense of fitting a new multiple-expansion engine, it was decided to put in a flue and return tubular boiler similar in most respects to the old boiler. In the limited space available it was found impossible to put in a Scotch boiler which would provide sufficient grate area for a simple engine of this size. In this boiler a grate area of 73.5 square feet was obtained, which has proved to be ample to develop approximately 400 horse power with the simple cylinder engine, cutting off at four-tenths of the stroke, the working pressure being 60 pounds per square inch. For a large grate area in proportion to the space occupied, and for a low working pressure, it would be difficult to design a boiler more efficient than the type here illustrated. It would surprise many to learn how many boilers of this type are now in use on vessels in American waters, principally engaged in harbor and river traffic. As a rule these boilers are long-lived, the old boiler on this vessel having lasted 18 years. This longevity is probably due to the low pressures of steam used, accessibility for cleaning and repairs, and good circulation. One of the weak points about this design is the rapid deterioration usually met with in the bottoms of the water legs, owing to poor circulation and inaccessibility for cleaning. This can be in a measure prevented by filling the legs with cement to a depth of 10 or 12 inches above the bottom, or up to a height of the level of the grate. The principal dimensions of the boiler in question are as follows:

Length on base	15 ft. 9 in.
Length over all, including steam chimney	17 ft. 0 in.
Width of boiler front	12 ft. 9 in.
Diameter of cylindrical shell	11 ft. 6 in.
Height of boiler from bottom of legs to top of shell	11 ft. 6 in.
Height of steam chimney above shell of boiler	7 ft. 0 in.
Diameter of steam chimney	7 ft. 3 in.

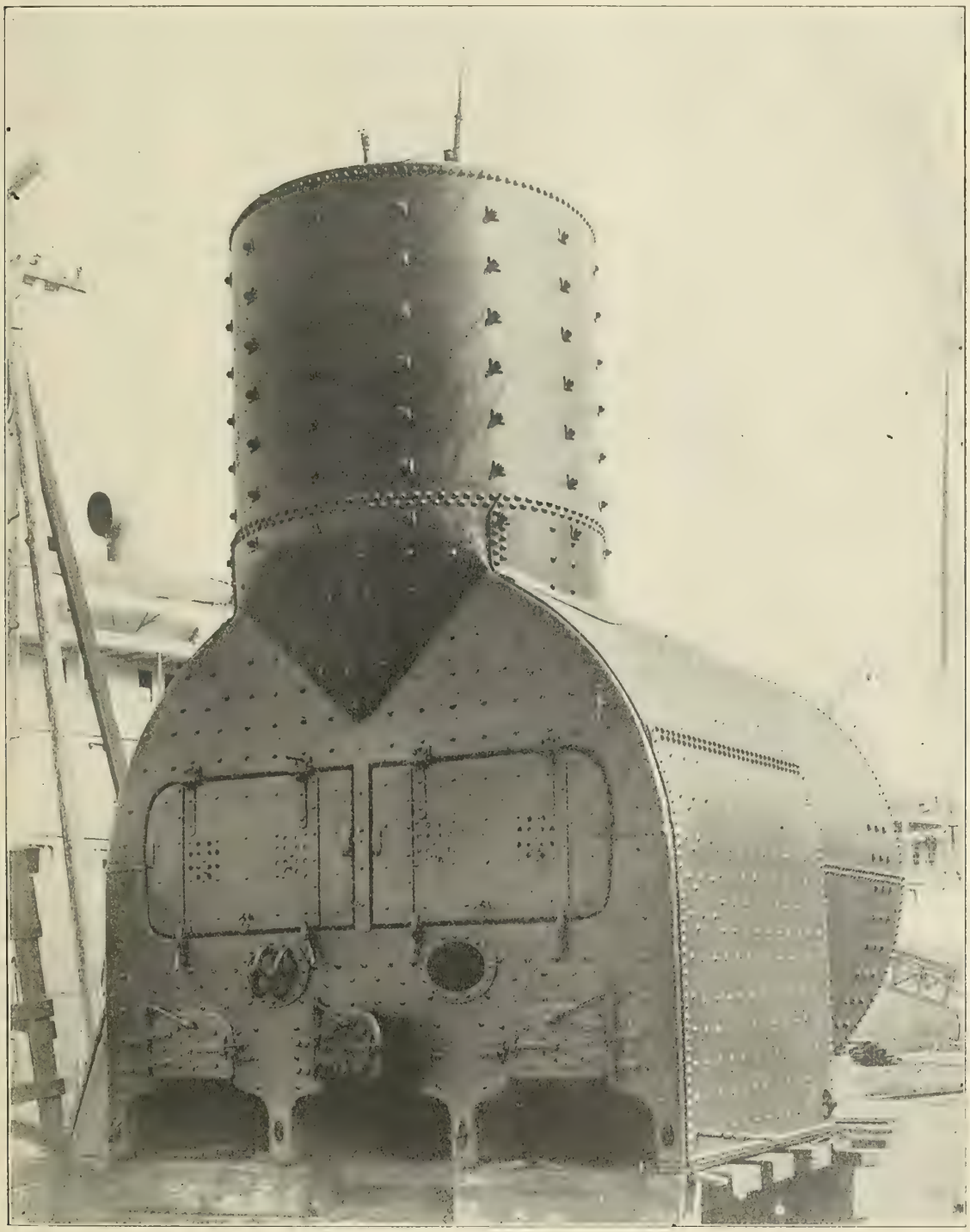
It will be seen from the cut that the plates were worked as large as possible, thus avoiding to a considerable extent the numerous riveted joints necessary for this type of boiler as built in the earlier days. The thickness of the cylindrical shell is 9-16 inch; of the front shell and side sheets, 19-32 inch; of the furnaces and steam chimney shell, 3-8 inch. Double riveting is used in all parts of the shell, the rivets being 7-8 inch and 1 inch in diameter.

There are 130 4-inch tubes, No. 10 B. W. G. They are made of the best quality of seamless drawn steel, and were each tested to a hydrostatic pressure of 500 pounds per square inch.



WORKING DRAWINGS OF THE FLUE AND RETURN TUBULAR BOILER OF U. S. REVENUE CUTTER PERRY.

All seams on the boiler were thoroughly calked both on the outside and inside. In fact, the workmanship throughout is of the highest quality and reflects credit upon the workmen of the Mare Island Navy Yard.



FLUE AND RETURN TUBULAR BOILER OF THE PERRY.

Durbin Floating Dock.—A floating dock, to be used at Durbin, South Africa, was recently launched at Swan and Hunter's shipyard. The dock has a lifting capacity of 4,500 tons, and is made up of five members—two side walls and three pontoons. The latter are connected to the side walls by movable joints, so that any one of the pontoons may be lifted by the dock for repairs. There are two complete sets of pumping engines—one in each wall.

GAS ENGINES AND THEIR TROUBLES.—V.

BY E. W. ROBERTS.

Methods of starting a gasoline engine are the same in principle for all types and classes. There are slight variations according to the character of the vaporizer and the igniting device, and sometimes in large engines what is known as a starter is employed.

It should be borne in mind that to start a gas engine successfully an explosion must be secured in the cylinder at the proper time to drive the crank in the running direction, and that the explosion must be of sufficient force to take the engine through at least another cycle, that is, with sufficient force to bring it over the center before the ensuing explosion has gained enough force to drive the engine backward. In engines where the lead of the igniter may be decreased to zero or made negative, there will be no danger of an explosion occurring before the end of the compression stroke, and consequently of driving the engine backward. Where, however, the igniter has a constant lead the possibility of securing too early an explosion should always be borne in mind. If the first explosion has sufficient force, the chance of the piston being retarded by the second explosion is very slight.

In the two-cycle engine the retarding impulse will quite frequently start the engine backward; and this is a point which the operator of a two-cycle should never forget, otherwise a serious accident might result. Occasionally a two-cycle engine will slow down from lack of proper fuel adjustment, and by the time the operator has opened the needle valve the proper amount the engine will take an impulse too early in the stroke for the speed at which it is running, and reverse. In a two-cycle engine having a constant lead or one in which the lead cannot be changed for starting, the best plan upon feeling the compression is to bring the starting crank around quickly, so that the momentum will carry the crank over the center in spite of the resistance due to the back pressure caused by the early ignition.

Quite a neat little trick in starting a two-cycle engine is to rock the flywheel back and forth two or three times, so as to pump the crank case full of mixture, and then give it a sharp jerk in a reverse direction. The flywheel should be pulled just hard enough to make the igniter snap, and this will give an explosion before the piston has reached the top of the stroke, starting the engine ahead and giving it sufficient impulse to take up the next cycle. It will be understood that this can be done only with such engines as have an igniter which will work equally well when rotated in either direction.

Engines having cylinders of four inches diameter or larger, especially when they are operated at high compressions, usually have a relief cock. This relief cock allows a portion of the mixture to escape, thus reducing the compression pressure and making it easier to turn the engine over. When starting, besides opening the relief cock, engines with variable-lead igniters should be set to ignite no sooner than at the end of the stroke. The relief cock should of course be closed and the lead of the igniter increased so soon as the engine is under way.

It is an excellent plan to train one's self to a regular order of procedure both for stopping and starting a gasoline engine. For instance, in starting the engine, first prime it and allow the priming charge to evaporate while attending to other necessary preliminaries. Then fill all oil and grease cups, no matter if they are nearly full already. Next test the electric circuit and see that it is in working order; see that the electric switch is closed and that the cocks to the pump are open, so that the water may be pumped either from the bilge or from the sea as circumstances demand. Then open the gasoline needle valve on the vaporizer a trifle more, if anything, than it should be when running. The relief cock being open and the igniter set at zero lead, give the crank one or two quick turns, never more than four or five, and the engine should start. Immediately close the compression cock, advance the igniter, and turn on the cylinder oil. If the engine does not start with four or five turns, don't break your back by continued cranking, but turn off the vaporizer and see what the matter is. A two-cycle engine should always get an explosion in two to three turns of the crank and a four-cycle engine in four to six turns.

In stopping the engine, first turn off the cylinder oiler about ten minutes beforehand, so as to allow the surplus oil to be carried out with the exhaust, and thus avoid clogging from oil remaining in the cylinder. Then open the igniter switch and shut off the gasoline at the vaporizer just as the engine stops. This will leave an unconsumed mixture in the crank case or the cylinder, according to the type of engine, and make it easier to start the next time. These instructions for starting and stopping will of course be modified according as the engine has special attachments for making one or more of the operations unnecessary. Sometimes the engine will start hard in cold weather or even when the humidity of the atmosphere is very great. Filling the water jacket with hot water and warming the vaporizer by the application of artificial heat will often help in this regard. Never use a direct flame, especially on the vaporizer, as a fire might ensue. An attachment for heating the ingoing air or a portion of it by drawing the fresh air from a small drum surrounding the exhaust pipe will sometimes be found of assistance, and especially so in moist weather. It is a wise precaution, when stopping for any length of time, to see that the bilge cock and the sea cock are not both open. Should they be left open the water may siphon up through the sea inlet and down through the bilge pipe, flooding the boat.

Pounding in a gas engine may be due to a tight piston, to loose bearings, or to premature ignitions. A tight piston may be due to the unequal expansion of the metals in the piston and in the cylinder wall. This is likely to occur only in a new engine where the piston has not been given freedom enough in the cylinder. Poor water circulation may cause over-heating and poor lubrication may permit too much friction, either one allowing the piston to cut and stick. The remedy for loose bearings is obviously to tighten them up. To tighten up a loose bearing and yet not have it too tight, turn the screws up snug and then turn them back from an eighth to a quarter of a turn. If the bearings are too tight, it is easily discovered by turning the flywheel when the piston is at the end of the out-stroke. Premature ignitions may be produced by other causes than too much lead of the igniter. Such ignitions may be

spontaneous, being produced by the mixture reaching the ignition temperature before the igniter operates. Premature ignitions are quite often due to over-heated air, and it is a good plan to run the engine with as cold air as circumstances will allow. Thin projections in the compression space, such as fins of metal, small flakes of carbon, or extremely light igniter parts, may become over-heated and fire the charge in the same manner as an ignition tube.

Muffler explosions, while themselves annoying, are not dangerous unless the muffler is too light in construction. A muffler should always be designed to withstand a pressure of one hundred pounds to the square inch, as this is the maximum pressure that may be obtained with the explosive mixture at atmospheric pressure. These explosions are caused invariably by unburned mixture finding its way into the muffler. Unburned fuel may reach the muffler through a leaky exhaust valve, or, in the regular operation of the engine, by charges that have failed to ignite in the cylinder. Mixtures that are too rich in fuel will allow an unburned portion to reach the muffler and mix with air that may find its way in from the atmosphere.

Crank-case explosions in a two-cycle engine are due either to a weak mixture or to delayed ignition. A weak mixture burns slowly and there is too much flame remaining at the end of the stroke for it all to get out of the exhaust port before the fresh charge reaches it in the crank case. Late ignitions have the same effect. The remedies are to increase the proportion of fuel and to increase the lead of the igniter. Sometimes, in a small boat, the engine may be running all right when the operator is near by it and crank-case explosions will begin as soon as he passes to the bow. This is due to the change in level of the boat and may be avoided by giving the needle valve a slightly increased opening just before starting forward.

Quite often an engine that has been running very nicely may be left for a short time after it has been stopped and will refuse to start when next called upon. This refers to a two-cycle engine and may generally be traced to a flooded crank case. The remedy is to clear the crank case either by turning the engine over and pumping it out, if there is not much gasoline in it, or by draining it through a small pet cock which is usually placed at the bottom of the case. If there is no pet cock it may be necessary to let the engine stand for a while and allow the gasoline to evaporate until the crank case is clear. If the crank case is badly flooded the only remedy is to remove the hand-hole plate and bail it out.

Smoke issuing from the exhaust is usually due to an excess of cylinder oil. Excessive fuel will occasionally cause a slight smoke, as will a fuel of a specific gravity greater than that ordinarily employed; as, for instance, if kerosene were mixed with the gasoline. Excess of fuel in the mixture may generally be discovered by the odor and by a stinging sensation in the eyes when the face is held over the exhaust.

When an engine falls off in power and yet takes its impulses regularly, the fuel mixture may not be right, and the gasoline feed should be altered a little at a time until a point is found at which the engine will give its highest speed. A late exhaust caused by slipping of the exhaust cam, a weak exhaust valve spring, or a too stiff spring on a suction inlet valve may also produce the same result. Quite often the exhaust passages become choked with carbon or the engine may lose compression. Loss of compression may be due to the piston rings becoming fast in their grooves or to a leaky cylinder-head gasket. Water finding its way from the crank case into the cylinder will dampen the explosion and occasionally short-circuit the igniter, resulting, of course, in a loss of power.

It is the custom on all gas engines to use asbestos for packing the joints. This should be about one thirty-second of an inch thick and should be carefully cut so as not to have a break through the gasket. Where the packing surfaces are narrow, dressing the metal with orange shellac will usually insure a tight joint. A plan that has been quite successfully employed is to chalk one face of the joint and saturate the gasket with silicate of soda. Several hours should be allowed for the silicate to harden, which it should do when in place on the joint, and with the surfaces tightly bolted together. This plan allows the gasket to be used a second time, as it will stick to the unchalked surface and break clean from the chalked face. An asbestos joint will be much tighter when made between two comparatively rough surfaces than when the faces of the joint are smooth, as the small ridges will help to hold the gasket in place.

For regrinding the valves of a four-cycle engine, pumice powder or grindstone grit are usually considered superior to emery, as they are not so likely to find their way into the wearing surfaces and produce cutting. A leaky valve stem should be remedied either by putting in a new valve or by boring out and bushing the bearing. When the valves stick and remain open, the spring may not be strong enough to return them to their seats or the valve stem may be coated with carbon or possibly bent. For lubricating valve stems kerosene is a much better lubricant than machine or cylinder oil.

(To be continued.)

Steamer Thomas Adams.—On June 19 the steamer *Thomas Adams* was launched from the Craig Shipbuilding Company, Toledo, O. The dimensions are as follows: Length, 385 feet; beam, 50 feet; depth, molded, 28 feet. The engine has cylinders 21, 34, and 57 inches in diameter by 40 inches stroke. There are two Scotch boilers 14 feet in diameter and 12 feet long and built for a working pressure of 180 pounds. The vessel is built for the Adams Transportation Company, Detroit, Mich.

Steamer Norumbega.—The steamer *Norumbega* was recently launched in the yard of Kelly and Spear, Bath, Me., at the order of the Maine Central R. R., for service between Bar Harbor and Frenchman's Bay. The dimensions are: Length, 157 feet; breadth, 30 feet 6 inches; depth, 10 feet 6 inches. There are two engines, built by the Bath Iron Works, of the three-cylinder, triple-expansion type, with cylinders 10, 15½, and 26 inches in diameter by 15 inches stroke. The revolutions in service are estimated to be 220 a minute. There are two Almy watertube boilers giving 88 square feet of grate surface and 2,720 feet of heating surface, and independent air and circulating pumps.

ELECTRICAL STEERING APPARATUS FOR SHIPS.

BY GEO. MCQUILKIN, JR., E. E.

To understand the operation of this apparatus it is necessary to clearly investigate the conditions under which the motive power for a steering gear is required to run.

If a steam engine is used, the admission valve of the engine is operated by a wire rope, shaft, or hydraulic telemotor from the chart house, conning tower, or the bridges, by the steering wheel at those points.

The steering wheel is mounted on a pedestal carrying an index pointer operated by the gearing connecting with the steering wheel, so that when the steering wheel is moved this index indicates the position it is desired to turn the rudder and is read in degrees port and starboard.

Assume that the rudder is in a fore-and-aft position; that is, its vertical plane coincides with the center line of the ship. In this position the index needle will be at the zero point, and if the top of the hand steering wheel is turned to port the index needle will move to starboard, and the rudder will move to starboard the same number of degrees that the index needle indicates. Similarly, for an opposite movement of the steering wheel, the index needle and rudder will move in the opposite direction, that is, to port.

During the turning of the steering wheel the wire rope, shaft, or telemotor, as the case may be, has opened the steam-admission valve on the engine in the direction necessary to admit steam to the proper side of the piston to cause the engine to rotate and turn the rudder in the direction as indicated by the index. As the engine rotates, it gradually moves the admission valve to its closed position, and this gear is designed so that when the rudder is at the required angle the admission is entirely closed. The engine then stops and will not move until the steering wheel is again turned. But the mechanism is arranged so that the steering wheel remains at the position placed and is not returned except at the will of the operator.

It will be seen that with this means a nicety of adjustment and a frequency of attention to the reciprocating parts are necessary, the engine under certain conditions being heavily loaded and at high speeds. Since only one steering engine is installed, its importance cannot be overestimated, even though the auxiliary manual steering wheels are installed in conjunction. An instance of this is the bursting of a steam pipe in the steering-engine compartment, and the impossibility of making necessary repairs and operating the auxiliary wheels at the same time.

In a twin-screw ship this would be overcome by the engines being used alternately, but in a single-screw ship sails would have to be resorted to.

The greatest power is required, when the ship is under way, to move the rudder from its center position to hard over, for then the force of the moving water projected by the screw against the rudder has to be overcome; while but little power is required to move the rudder from the hard-over position to its center position, for then the force of the moving water assists the rudder in that direction.

It is obvious, in the latter condition, that if the engine has the same valve opening as when it moved the rudder from the center to hard-over position, the load having been greatly reduced due to the assistance of the moving water, the engine will tend to speed up, and a continuance of this class of service may bring severe strains on the engine and its mechanism. If, furthermore, the engine is located near the rudder post, it will be necessary to carry the steam and exhaust pipes through bulkheads, cargo spaces, and shaft alleys, the latter being ordinarily of small proportions, and in the event of an accident to the main engine shafting they might interfere with making repairs.

It is not intended here to give the impression that electrical steering apparatus will be a remedy for all the above faults, but to make a comparison of the two systems. The electrical steering gear has to perform service identical to that of the steam steering gear. It works on the principle of a Wheatstone bridge (Fig. 1).

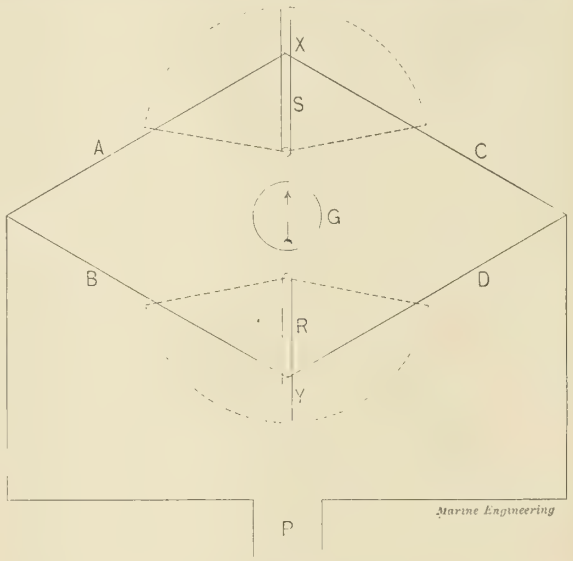


FIG. 1.

A, *B*, *C*, and *D* are four arms of wire of equal resistance values. At the junction of *A* to *C* and *B* to *D* is an instrument, *G*, for indicating the flow and direction of current that may pass over *XY*.

At the junction of *C* to *D* and *A* to *B* current is supplied, and if the ratio of *A* to *C* equals that of *B* to *D* in resistance value, there will be no difference of pressure (potential) at *XY*, and the instrument *G* will not indicate, and the system is said to be in "balance." But if the value of *A* is changed, this makes the arms of unequal relative value, and the system is out of "balance," and the instrument *G* will indicate, the direction of indication depending on the value of *A* being made greater or less than originally.

If the value of *A* is made greater, then it will oppose the flow of the current more than it did before, and the current will flow in a greater proportion in *B B;* and since the value of *C* was not changed, a part will also flow from *B* to *Y*, through *G*, and cause *G* to deflect. On the other hand, if *A* were made less, then relatively more current will flow over *A C*, and, since the value of *D* has remained the same, a portion will flow from *A* to

X, through *G*, to *Y* to *D*, and instrument *G* will deflect in an opposite direction to that when the value of *A* was increased, because the current has entered *G* in an opposite direction. In the first case the current flowed from *B* to *Y*, through *G*, to *X* to *C*, and in the second case it flowed from *A* to *X*, through *G*, to *Y* to *D*. If the value of *A* were decreased, assume one-half, the "balance" of the system could have been settled by decreasing *B* one-half, for then the two arms would again have their values in the same ratio to *C* and *D*. Likewise if the value of *B* were disturbed, a "balance" could be obtained by disturbing *A* in equal proportion, and similarly for *C* or *D*. If a mechanism were connected to the needle at *G*, so that when the value of *A* or *C* were disturbed the deflection of the needle would disturb the value of *B* or *D* respectively, then the system would be automatically *"balanced."*

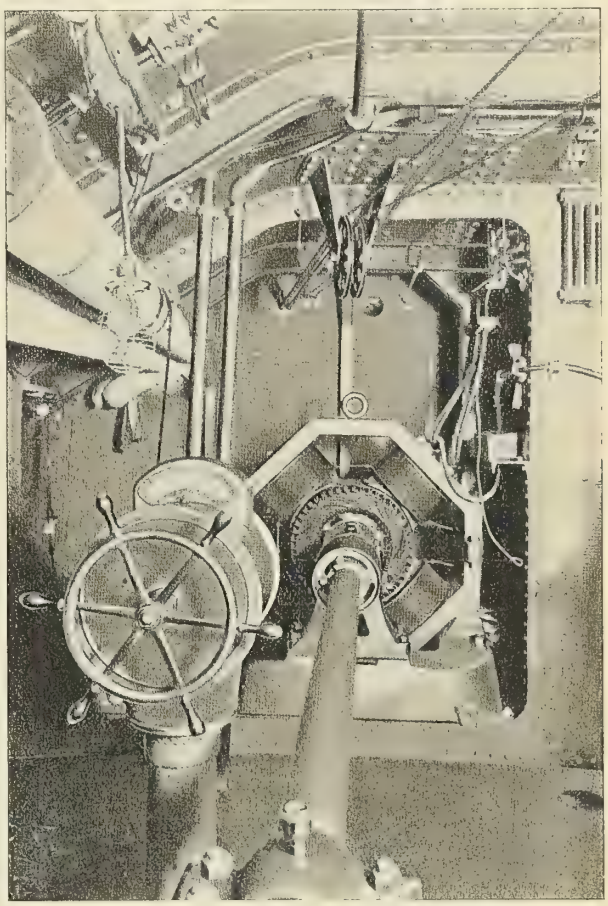
To apply the above principle to the practical operation of a steering gear the instrument *G* is replaced by a motor *M*, reversible as to direction of rotation and operating the gearing to the rudder and the contact arm *R*, over *B* and *D*, so that current flowing through the "balance" wire *X Y* will operate the motor to move the contact arm *R* and automatically "balance" the system, decreasing or increasing *B* or *D* in exact proportion to the decrease or increase of *A* or *C* respectively by their contact arm *S* (which is operated by the hand steering wheel, Fig. 2), so that when the two contact arms *R* and *S* correspond no current will flow and motor will stop. This would be a simple arrangement but for the heavy currents that would have to be carried in the resistance arms, causing excessive sparking and consequent deterioration at the contacts. This and many other disadvantages have been overcome in the following manner:

An engine drives a dynamo at constant speed. The dynamo armature current is conducted direct to the armature of the steering motor, whose fields are constantly excited (Fig. 2). The dynamo will not generate current until its fields are excited, and they are supplied by current from *X Y*. Current is supplied to the motor field and resistance arms from a constant potential source *P*. The same results are obtained as were set forth in connection with Fig. 1. With the contact arms in position, shown in Fig. 2, the system is in balance; there being an equal amount of resistance in each arm, there will be no difference of potential between *X* and *Y*, and consequently no current will flow through the field *G*, and the dynamo will not generate. The hand wheel is turned so that the contact arm *S* is moved to the position shown by the dotted line, the balance of the system is disturbed, and current will flow in different quantities in *AC* and *BD*, causing a difference of potential between *X* and *Y*, exciting the fields *G* of the dynamo, which will send a current to the motor.

The motor revolves, carrying the contact arm *R* until this arm has moved over a value of resistance *B*, proportionate to that cut out of *A*, and then the system will again be in balance, there being no difference of potential between *X* and *Y*, no excitation of dynamo fields, and the dynamo stops sending current to the motor, which thus comes to rest.

To reverse the direction of rotation of the motor the contact arm *S* is moved in the opposite direction, the action being identical to that outlined above.

Various modifications of the above simple set are in operation; one set is as shown in Fig. 3. The motor *M-2*, exciter *E* (dynamo) set has been added. The motor drives the exciter at a constant speed. The exciter field has been excited by unbalancing the system, and this generates, feeding the main dynamo field. This avoids the use of heavy wires in the line and resistance arms for carrying the current required for the operation of the fields of the main dynamo, which is about 75 Kw., whereas the motor generator is about 1 Kw. The current required in the resistance arms is about 2 amperes by this method, or not sufficient to light 4 incandescent lamps.



ELECTRICAL STEERING GEAR, RUSSIAN CRUISER VARIAG.

Another arrangement is as shown in Fig. 4. The engine driving a dynamo also on the same shaft drives by means of clutch couplings the motor exciter set *E*. In this method the dynamo fields are supplied by the exciter of the motor exciter set, and the motor exciter fields are supplied by the varying potentials from *XY*, as in Fig. 3. The motor is driven as a dynamo and supplies the resistance arms and also the fields of the steering motor.

This method eliminates the dependence on an outside supply for its operation and makes it self-contained.

On the switchboard panel are fitted double throw switches, so that, in the event of trouble in engine or

dynamo, by throwing the switches the dynamos ordinarily in use for lighting the ship may be used. In this event the motor exciter set shaft can be disconnected from the dynamo by clutches, and after the switches have been thrown over the connections would be as shown in Fig. 3.

The steering motor having a rotary motion, all trouble from reciprocating parts is avoided, and, having only two ring oiled bearings, the attention required is reduced to a minimum.

The engine and dynamo being located in the dynamo room under the supervision of the attendant in charge of the other engines and dynamos, proper attention is given to the working machinery, and, in the event of trouble, the necessary attendance is at hand. The wiring does not occupy or heat the spaces as in case of steam pipes for the same work, and does not require the attention that joints in pipes do, or as large holes in the bulkheads. It is true that the size of steam pipes to the dynamo engines will have to be slightly increased, but this increase is almost imperceptible when compared with the long lengths required for an engine that is located in the steering gear compartment. It also leaves the steering compartment free from piping, so that the auxiliary hand gear can be operated in any event.

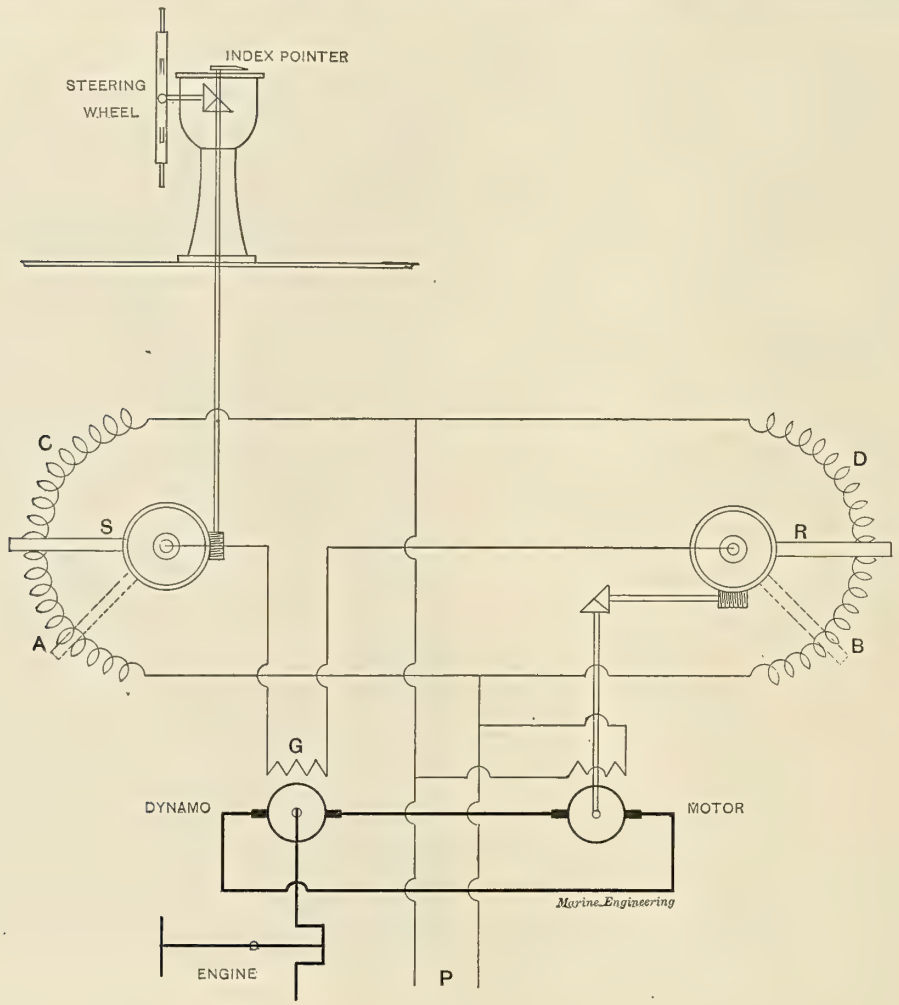


FIG. 2.

The question of actual efficiency can only be arrived at in comparing the two cases by a test of each individual case. The greatest loss in the steam gear would appear to be the loss due to the condensation in the steam and exhaust mains, plus the loss due to setting the engine valves at three-quarters or full stroke in order to clear the cylinder of water, and in the electrical system the power required to run the dynamo and engine empty, including the efficiency of the several machines used. In general, however, the fineness of control in handling the ship is greater in the electrical system than in the steam gear. This can more readily be appreciated in handling the ship during manœuvering in squadrons, on the sea during stormy weather, in approaching a dock, or navigating a tortuous channel.

The stretching of wire ropes, the excessive power required for shafting, and the liability to leakage in hydraulic gear for operating the admission valves of the steam engine are avoided, and with the proper protective devices installed on the wires conducting the current from the steering wheel near the steering station to the rudder, there is no apparent cause for any lengthy disability of the electrical system. In Fig. 5 is shown the variation in the power required for turning the rudder by the electrical system.

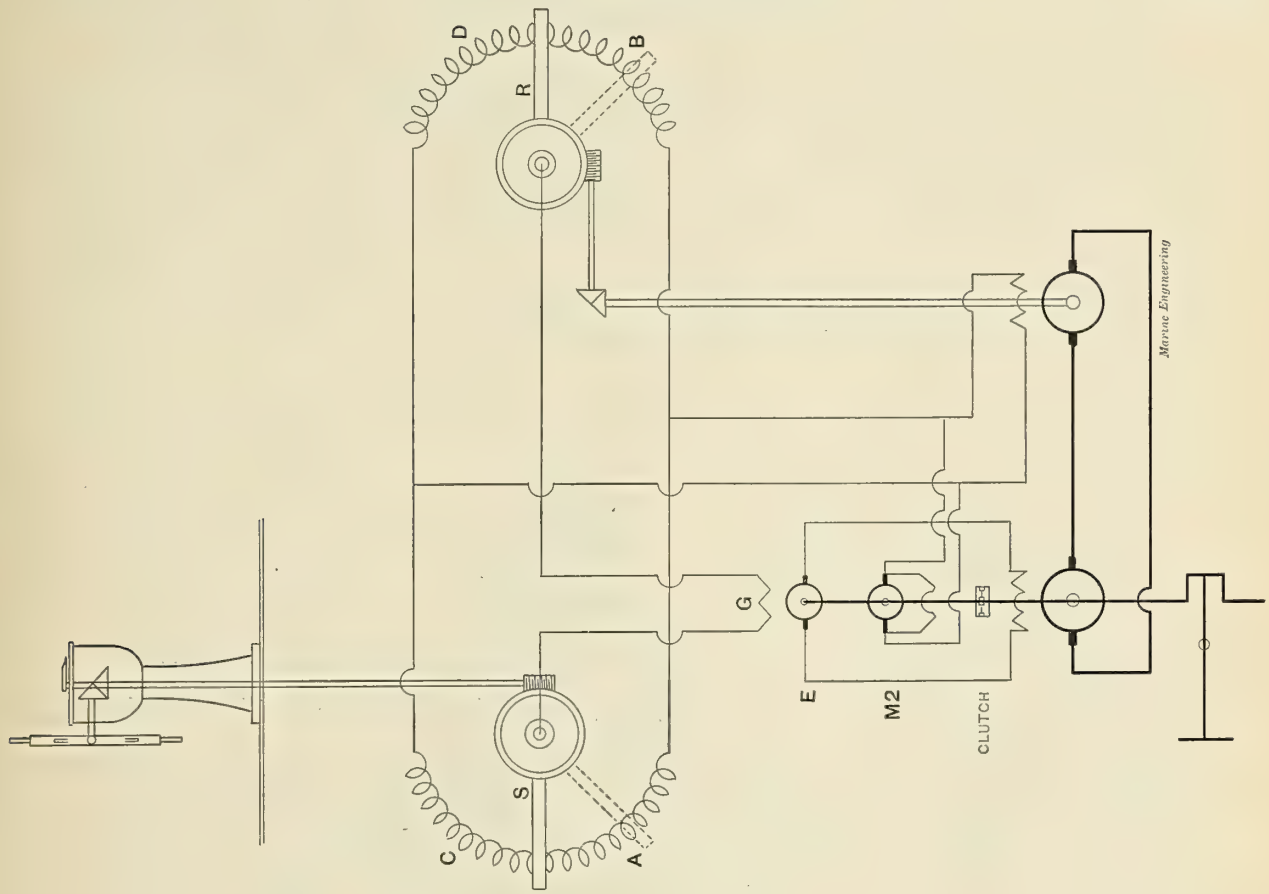

D
B
R
G
E
M2
CLUTCH
Marine Engineering
S
C
A

FIG. 4.

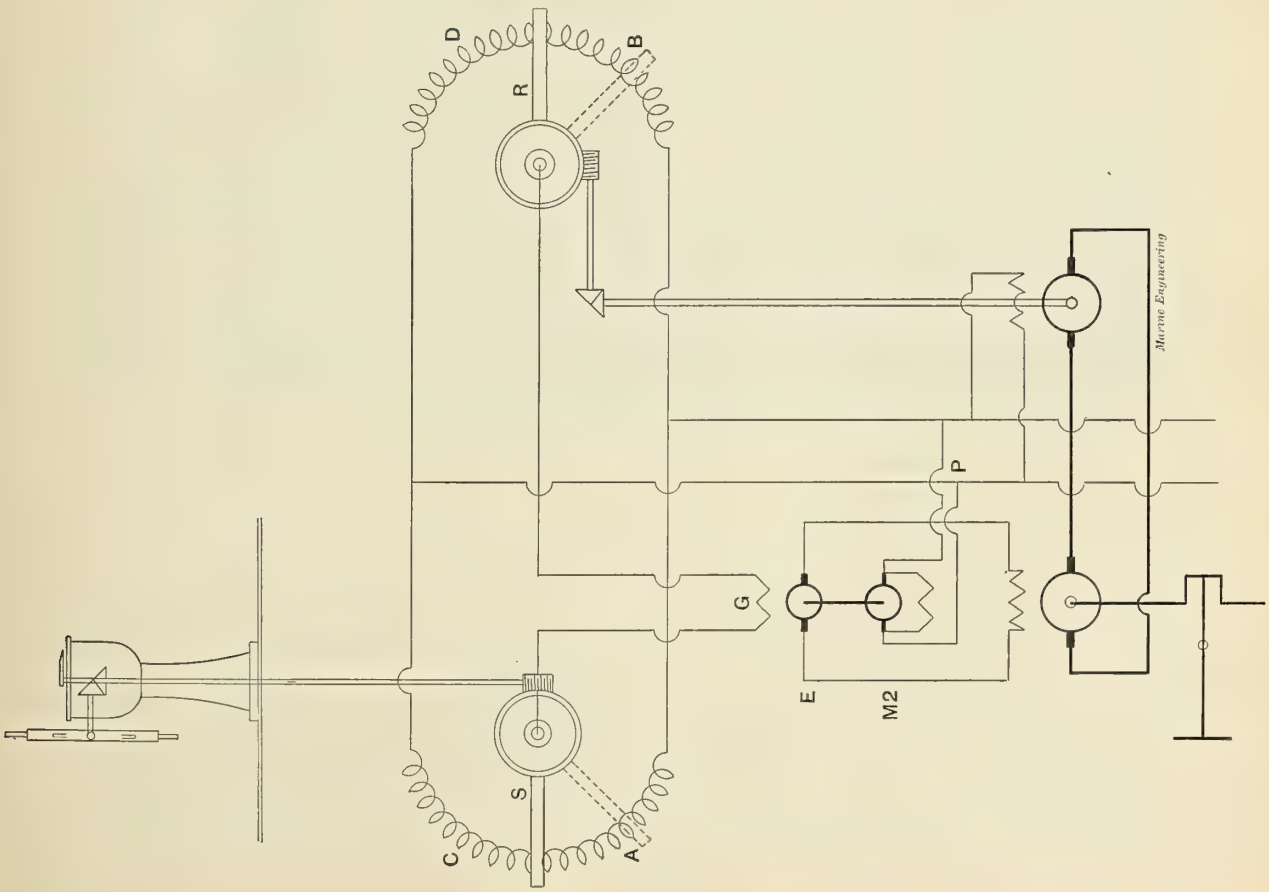

D
B
R
P
G
E
M2
Marine Engineering
S
C
A

FIG. 3.

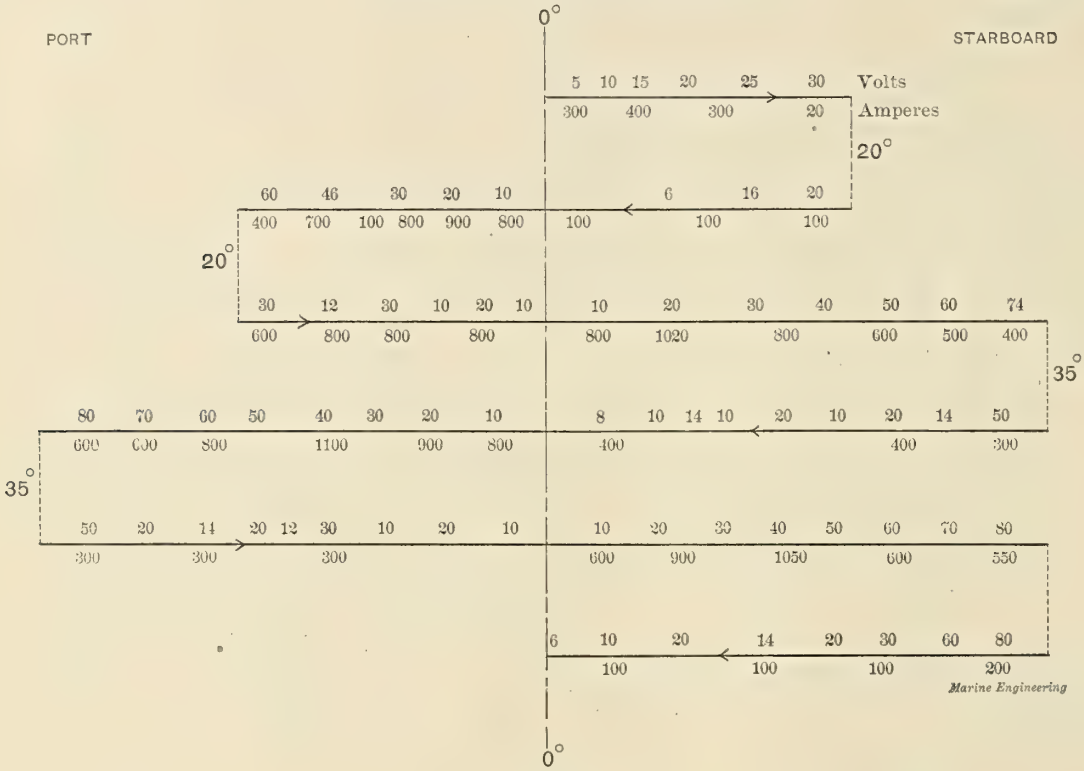

PORT
STARBOARD
0°
5 10 15 20 25 30 Volts
300 400 300 20 Amperes
20°
60 46 30 20 10 6 16 20
400 700 100 800 900 800 100 100 100
20°
30 12 30 10 20 10 10 20 30 40 50 60 74
600 800 800 800 800 1020 800 600 500 400
35°
80 70 60 50 40 30 20 10 8 10 14 10 20 10 20 14 50
600 600 800 1100 900 800 400 400 300
35°
50 20 14 20 12 30 10 20 10 10 20 30 40 50 60 70 80
300 300 300 600 900 1050 600 550
6 10 20 14 20 30 60 80
100 100 100 200
Marine Engineering
0°

FIG. 5.

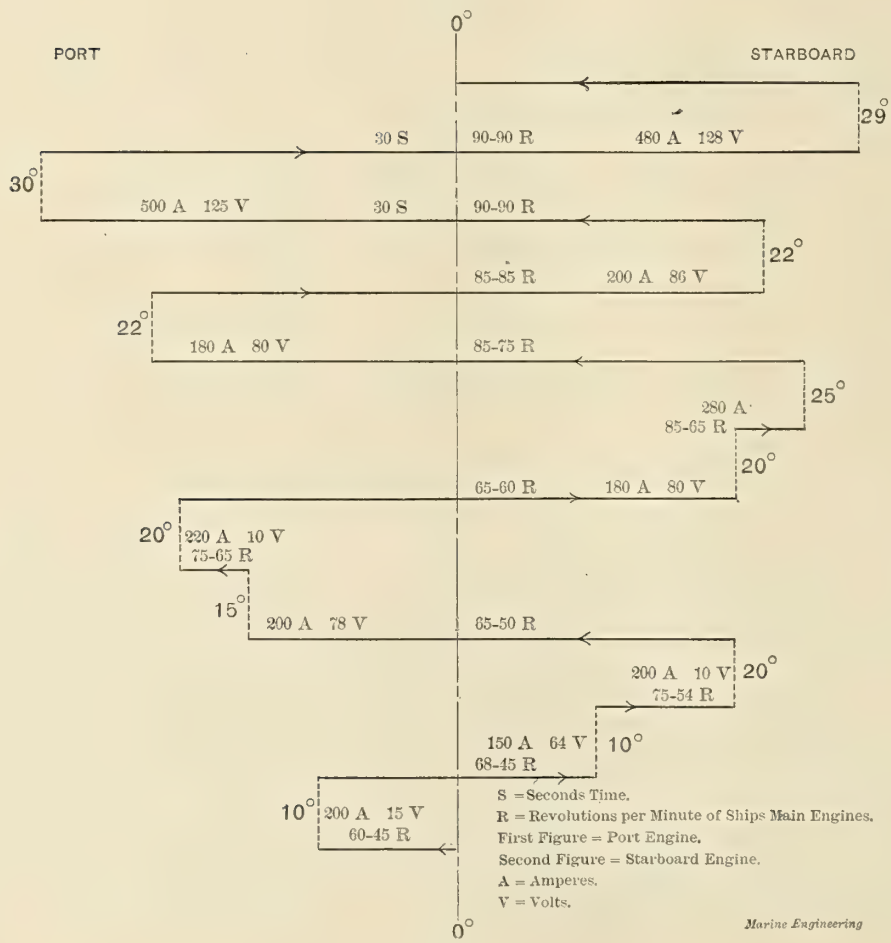

0°
PORT
STARBOARD
29°
30 S 90-90 R 480 A 128 V
30°
500 A 125 V 30 S 90-90 R
22°
85-85 R 200 A 86 V
22°
180 A 80 V 85-75 R
25°
280 A
85-65 R
20°
65-60 R 180 A 80 V
20°
220 A 10 V
75-65 R
15°
200 A 78 V 65-50 R
200 A 10 V 20°
75-54 R
150 A 64 V 10°
68-45 R
10°
200 A 15 V
60-45 R
S = Seconds Time.
R = Revolutions per Minute of Ships Main Engines.
First Figure = Port Engine.
Second Figure = Starboard Engine.
A = Amperes.
V = Volts.
Marine Engineering
0°

FIG. 6.

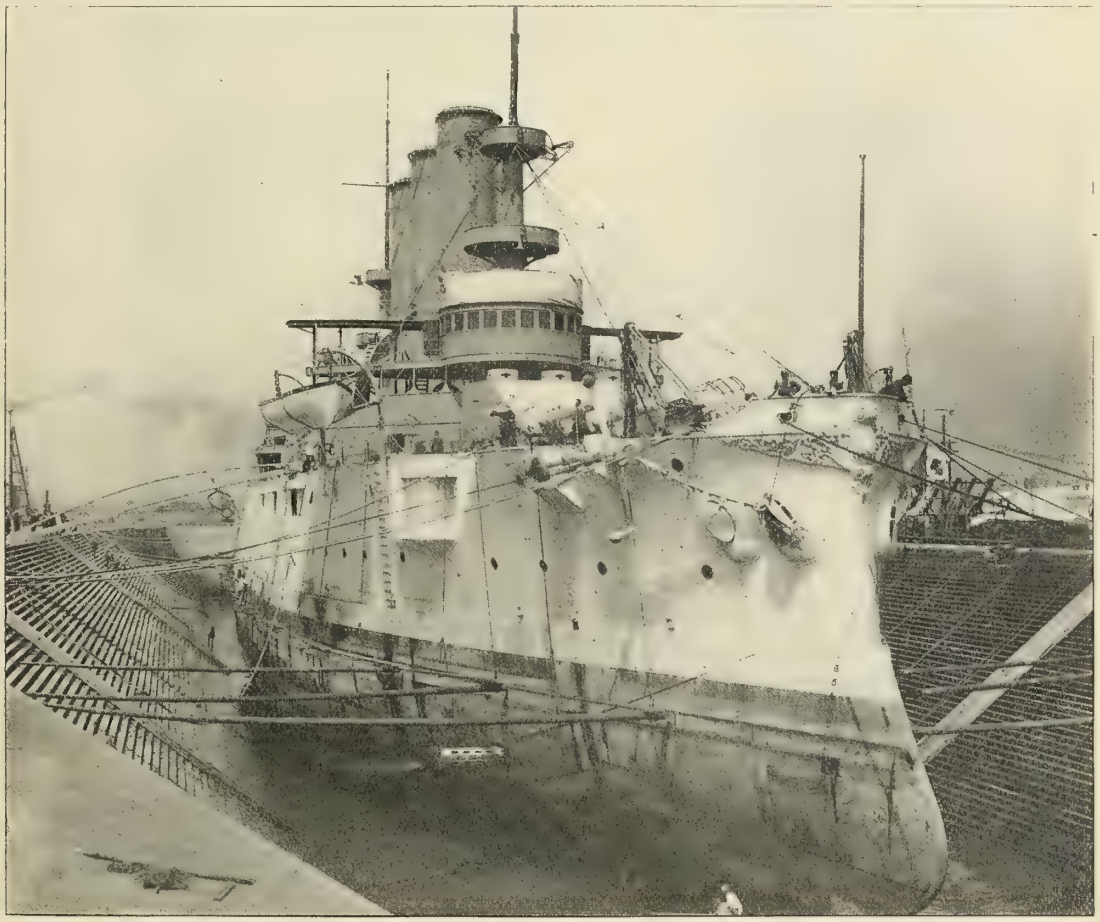
The figures were taken from a ship having a speed of nearly 18 knots, and a rudder of 197.8 square feet area, and a maximum helm angle of 35 degrees.

The figures on the upper side of the line are values in volts, and the figures on the lower side of the line are values in amperes. The figures show that the maximum power was required to put the rudder hard-over from a center position, and that little power was required to bring the rudder from hard-over to the center position. The rudder was first turned from center position to 20 degrees starboard, then back to center position to 20 degrees port, then to center to 35 degrees starboard, and so on.

The New Battleship Maine.

Herewith is presented a view of the new battleship *Maine,* taken before her official trial and while in dry-dock in the New York Navy Yard. The illustration is reproduced by courtesy of the *Brooklyn Daily Eagle.*

After being floated from the dock the ship proceeded to Boston and thence to the Cape Ann course. The contract required that a speed of 18 knots be maintained for four consecutive hours. The figures given out for the speed were 18.1 knots, although it is stated that tidal corrections will bring this figure up to 18.3 knots.



THE NEW U. S. BATTLESHIP MAINE IN DRY-DOCK.

In Fig. 6 is shown the power required under variable conditions of main engine revolutions.

The maximum power required in one particular case was about 112 H. P. to put the rudder from hard-over to hard-over, the ship having a speed of over 22 knots.

The instruments for measuring the volts and amperes, being permanent attachments on the switchboard, furnish a ready means of detecting, at stated periods, any inequalities of the power required for the gear. If the electrical system is used in conjunction with a steam gear having a helm angle indicator or a telemotor, the wires for these instruments can be included in the cable of small wires in use for the electrical system, as this cable is carried over approximately the same length as would be required for the above instruments.

The over-all length of the *Maine* is 388 feet, the extreme beam 72 feet 2 1-2 inches, and at the mean load draft of 23 feet 6 inches the displacement is 12,300 tons. The main battery consists of four 12-inch B.L.R. and sixteen 6-inch R.F. guns, and in the secondary battery are eight 6-pounders, six 1-pounders, two Colts, and two 3-inch R.F. field pieces. The 12-inch guns are mounted in two barbettes with armor of 12 inches maximum thickness, which are placed on turrets of 12-inch armor. This great vessel is propelled by two sets of triple-expansion engines, the diameters of the cylinders being 38.5, 59, and 92 inches and of 42-inch stroke, designed to indicate 16,000 horse power. Twenty-four Niclausse boilers supply the steam. The total grate surface is 1,353 sq. ft. and the total heating surface 58,104 sq. ft.

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TRUSTS and trade combinations represent one of the important industrial tendencies of the age. A further step in this direction along lines relative to marine construction has been recently announced in the formation of the United States Shipbuilding Company, including the following yards: Bethlehem Steel Company, South Bethlehem, Pa.; the Union Iron Works, San Francisco, Cal.; Bath Iron Works and Hyde Windlass Company, Bath, Me.; Eastern Shipbuilding Company, New London, Conn.; Harlan and Hollingsworth Company, Wilmington, Del.; Crescent Shipyard, Elizabeth, N. J.; Samuel L. Moore and Son Company, Elizabeth, N. J.; and the Canda Manufacturing Company, Carteret, N. J. At first thought it might seem difficult to understand the reason for a combination involving the yards mentioned, since it will in no wise furnish any exclusive control of operations on the Atlantic coast or elsewhere. Further consideration shows, however, that in this case no such exclusive control seems to be contemplated. In other words, the combination seems to have been formed without reference to the idea of a monopoly, regarding either territory or character of product. The obvious principle which the combination clearly embodies is that of including representative yards in different parts of the country suited either to general or to special classes of work, together with provision for supplying guns, armor, and ordnance supplies for naval contracts. The obvious plan of the combination will be to classify and standardize its output so far as may be possible, and then, by a suitable distribution of work, keep each yard busy on that type of construction which it is best fitted to carry out efficiently. With this thought in view it is clearly seen that the entire field of marine and naval construction is well covered in the various yards included, and that any order, no matter what, from a battleship to a torpedo boat or revenue cutter, or from a transatlantic liner to a tramp freighter or tugboat, or from a steam yacht to a houseboat, may be efficiently cared for in a yard well suited to the work in question. This seems to us the true function of the combination. It has in view increased efficiency of construction, but without monopoly or restriction of outside builders in the same field.

It cannot be too strongly realized that the secret of the highest success in any industrial plant involves the keeping, so far as possible, every wheel turning and every piece of productive equipment constantly at work and on that type of work which it can handle to the best advantage. This ideal can never be realized, of course, in a single yard where all classes of construction are handled. A long step toward such a condition may, however, be made if, in a central office, large numbers of orders may be classified and distributed with reference to the type of construction, so that in each yard the economy of specialization may be realized to the fullest practicable extent.

The formation of the United States Shipbuilding Company along these lines seems to be a wise move, and we may wish the combination the successful and prosperous career which its plan of work seems to deserve.

WE have previously in these columns referred to the questionable policy on the part of the Government of building battleships in the navy yards rather than by contract with private builders. The Navy Department, of course, has no choice in the matter and can only carry out the direction of Congress. In accordance, therefore, with the law authorizing the construc-

tion of the two battleships *Connecticut* and *Louisiana,* the Department is proceeding with the preparation of the building slip for the former at the New York Navy Yard. This work, consisting chiefly of pile driving, will be carried on through the fall and winter, and it is expected that the keel will be laid in the early spring.

The bids for the sister ship, the *Louisiana,* will be opened October 1, and it is understood that strict adherence to the Department's plans will be insisted on in order that the comparison between the two ships as to cost, workmanship, speed of construction, etc., may be as broad and accurate as possible. Usually, in bids for Government work and on Government plans, some variation in detail may be allowed in favor of modifications proposed by the builder. In this case, however, it is the intention to have the two ships identical in all respects, and the plans prepared by the Government will, therefore, be strictly adhered to.

This will serve as the basis for a most interesting comparison. It has long been accepted as a general proposition that work in a navy yard is more expensive, both in time and money, than by private contract, and the reasons have not been far to seek. Briefly, the more important are as follows: A shorter working day; a higher average price for labor per man-hour; the difficulty of introducing piecework, and the consequent reduction of the output per man-hour as compared with private yards; the difficulty, with such labor as must in any yard be paid by the hour, in keeping the output per man-hour for the navy yard laborer up to the point realized by the private builder. It is this last item, intangible in character and uncertain in amount, which has been largely blamed for the so-called inefficiency of navy-yard work. The cost of material and equipment generally in the two cases should be the same. The average prices paid for labor are matters of record, and the chief remaining item is this general charge of inefficiency made against the navy yard laborer. Whatever in amount this may be, it must be laid to the charge of the system in vogue in Government work, and must be either an inherent and necessary feature of such work, or accidental and unnecessary and therefore removable by improved methods of administration. The plan proposed in the building of these two battleships should throw some light on such questions, and should aid in making possible a more intelligent study of these problems of the administration of public works.

WE publish in another column an article on the influence of shallow water on the speed of ships; and while we cannot fully agree with all the points taken by the author, we are glad to give the article publicity, in the hope that it may stimulate others to contribute their experience along the same lines. The author claims that no vessel can go in shallow water faster than the natural wave of translation, and that the speed of such a wave is therefore an upper limit beyond which, no matter what the power may be, no vessel can be forced. In this connection we wish simply to draw attention to two points: First, the shallow water wave is not quite the same as the ideal wave of translation, which is only found normally in a canal or restricted channel, and it is somewhat uncertain to reason from one type to the other.

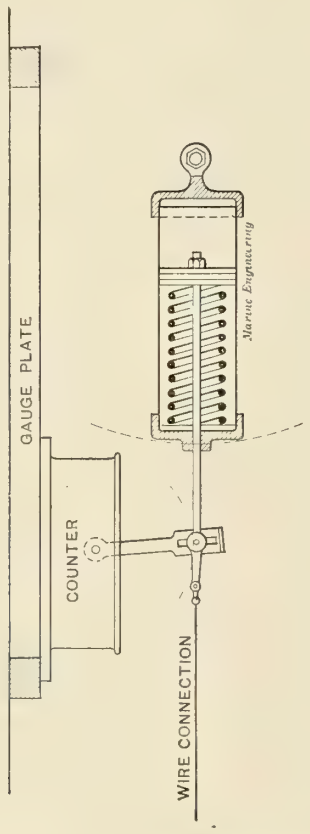
Second, the assumption that a ship cannot be propelled through shallow water at a speed faster than that given by the formula cited must, after all, be recognized as an assumption only. It is very sure that by external means, such as towing along a canal, a boat may be forced through shallow water at any speed quite independent of the depth of the water, but of course with an expenditure of power sufficient for the circumstances of the case. There seems to be no reason why, with the provision of sufficient power within the boat itself, similar results with the usual means of propulsion might not be reached. It is a fact, however, that at speeds perhaps approximately indicated by the formula proposed by Mr. Stevens, the resistance of boats in shallow water is likely to increase at an excessive rate; and while there is perhaps no reason for considering such speeds as an absolute limit, it is a fact that any excess in speed over some such limit must be paid for at so high a rate measured in horse power that even with excessive power the gain in speed is but slight, and there results, therefore, a practicable limit beyond which it is not economical to attempt to drive boats in shallow water. This is really the main conclusion of Mr. Stevens' article. The question as to where this speed comes in, and whether determined by the depth of water alone, as he proposes, or by the depth of water and the size of boat conjointly, is a question to be determined by experience, and to this end we shall welcome communications from those who may have had in their experience opportunities for observing and recording facts bearing upon these matters.

COMMUNICATIONS.

Troubles with Counter Gear.

Editor Marine Engineering:

Most engineers have, at some time or other, experienced difficulty with the gearing employed for operating engine revolution counters. Several years ago, while attached to a Cramp-built ship, we had all kinds of trouble with the counter gear. This revolution recorder was one of the ordinary circular-dial affairs, and in itself was all right. The gage-board to which it was secured was located on the forward engine room bulkhead, about at the height of the high-pressure cylinder and 10 feet outboard from the same on the starboard side. To transmit the reciprocating motion from the high-pressure crosshead to the counter lever necessi-



SPRING FOR TAKING UP LOST MOTION OF COUNTER GEAR.

tated a complex system of shafts, rods, bell cranks, and levers. Theoretically the gear was perfect and correctly proportioned, but practically it slapped and rattled, and wore down in the working parts to an extent that caused us considerable annoyance. On several occasions, by the breaking of small pins or the slipping of some of the connections, it gave out entirely.

By a combination of the engineering talent on board, a new gear was evolved which it was anticipated would obviate all of the annoying features of the old gear. This apparatus consisted of a cylinder, made of a piece of 2-inch brass pipe, which was so fitted as to oscillate on a stud, or stanchion, screwed into the fore-and-aft bulkhead close up to the gage plate. In this cylinder was a piston and a piston rod, the lower end of which was secured by a pin joint to the end of the counter lever. A spiral steel spring was fitted inside the cylinder between the piston and bottom head. The motion was imparted to the lever by means of a piece of 3-32-inch brass wire connecting to a lever on a fore-and-aft shaft which was rotated by means of a connection to the high-pressure crosshead of the engine. Brass chain and sheaves were, of course, fitted where the lead of the wire was changed. The operation was that, on the down stroke, the spiral spring was compressed by the piston, and on the opposite movement the spring forced the piston, and consequently the counter lever, up again. The wire was thus kept in tension at all times.

The accompanying rough sketch shows how the spring cylinder was arranged. For about a week after this gear was fitted no trouble was experienced with it. To all appearances it was working perfectly, but one day it suddenly gave out, much to the chagrin of those who had gotten the apparatus up. Upon examination, it was found that the constant work brought on the spring by 125 revolutions of the engine had been too much for it and it had broken. The chief engineer, after puzzling over the matter for some time, decided to try another experiment. This time he left the spring out entirely, threw away the lower head of the oscillating cylinder, and made a connection by a length of 3-8-inch brass pipe from the condenser to the top of the cylinder. The piston was packed, and in place of the spring we now had a vacuum of 25 inches for the wire to pull against. This arrangement was found to work perfectly, and it is in use now, having stood wear and tear for over two years without any derangements.

C. A. Chalkley.

A Patent Stern Tube.

Editor Marine Engineering:

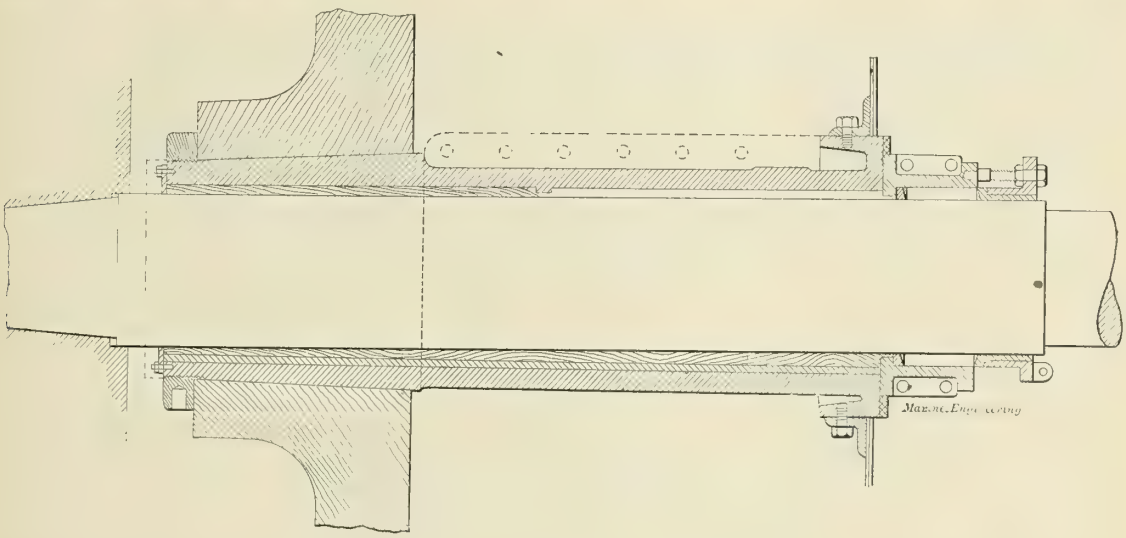
The stern tube is one of the most important parts of a ship, and a design which is conducive to good working and ease of overhauling is much to be desired. The ordinary form of stern tube, such as used in the merchant marine, is, of course, well known to all marine engineers, and a lengthy description is unnecessary. We may simply note that it consists essentially of a cast-iron tube containing a brass bush with dovetails, these dovetails holding strips of lignum vitæ as a bearing material. In some stern tubes the brass liner is dispensed with, the lignum vitæ strips being driven directly into the dovetails of the cast-iron tube, but this practice is to be condemned except in very small vessels.

In single-screw ships the distance between the rudder post and the stern-tube nut limits the length of the brass liner carrying the lignum vitæ strips, the brass liner being short enough so as to be readily withdrawn in case of necessary repairs. In ordinary stern tubes it is necessary to take off the propeller and draw the shaft in, in order that the lignum vitæ bearing strips may be renewed; and this proceeding entails a large expense, that is, if the shaft is drawn in solely for the purpose of removing the bearing material.

Keeping this in view, the problem presents itself as

follows: To design a stern tube which shall allow the packing wood to be removed and renewed without taking off the propeller and drawing in the tail shaft. A British marine engineer, well known on both sides of the Atlantic, has offered the stern tube shown here as a design intended to fulfill these conditions, and quite a number of them are in use, one of them having come under the personal observation of the writer.

Referring now to the accompanying drawing, the stern tube is made in separable halves and of cast iron. It will be noticed that the construction of the lower half differs from the upper one. The halves are securely bolted together, four of the bolts being fitted, and then the tube is passed into the hole in the stern frame and fastened by a nut on the after end in the usual manner. The shaft, when revolving, wears the bearing strips on the bottom, while the wear on the top wood is very slight. In this design the top lignum vitæ strips are therefore driven directly into the dovetails of the stern tube, and these strips are only 3 feet long. Of course, if these top pieces are to be renewed, it would be necessary to take off the wheel and draw in the shaft for several feet, but this contingency occurs but once in every eight or ten years.



A PATENT STERN TUBE, MADE IN HALVES.

Now, looking at the lower half, it will be seen that this contains a brass liner fitted with dovetails into which the lignum vitæ strips are driven. The center line of the bore of the bottom half has a downward inclination from aft to forward of 1-8 inch per foot. This increases the diameter of the bore from the center line of the shaft, and, while the brass liner is 5-8 inch thick throughout, to make up the deficiency the thickness of the wood in the dovetails is increased from 7-8 inch aft 1 5-8 inch forward. The stuffing box and gland are made in halves, so that they may be taken off the shaft entirely. As shown in the drawing, the shaft has two distinct stuffing boxes, the forward one leading into the shaft alley and the after one into the after peak.

Having now described the stern tube without going into those details of construction which may be readily seen on the drawing, it may be well to describe the method of removing the old wood and replacing with new.

Underneath the hub on the stern frame is a step bolted to the frames, and put on in such a manner as not to interfere with the propeller. This step is not shown on the drawing, but it serves for a support upon which a screwjack is placed. This jack lifts the shaft and thus releases the bottom brass liner of its load. The after-peak stuffing box and gland are then taken off, and the brass liner, with the lignum vitæ or the lignum vitæ strips alone, are drawn into the after peak and renewed without disturbing the propeller and the shaft.

One must admire the simplicity of the means by which the problem was solved, as well as the details of the design and the engineering skill with which the idea was carried out. In practice, however, it is found that other conditions enter and render difficult the carrying out of the repairs in the manner intended.

It was the fortune of the writer to have personal supervision of an attempt to carry out practically the idea embodied in this design of renewing the lignum vitæ strips without removing the wheel and drawing in the tail shaft; but although use was made of every facility of a well-equipped repair shipyard, it was not found practicable to carry out the intentions of the designer.

The jack was put under the stern shaft and lifted it against the top wood as far as it would go, and the shaft was also lifted by means of a tackle in the shaft alley. The stuffing box and gland were taken off, but the wood and the liner could not be started, and at last the old method of taking off the wheel and drawing in the shaft was resorted to.

The reasons why the wood would not come out are presumably many, and some may be mentioned. The shaft is flexible and wears more at the after end of the stern tube than at the forward end. The ship itself is flexible, and when in dry-dock assumes a different shape than it does while floating, thus binding the shaft when the ship is in dry-dock. Still other reasons might be found for the trouble met with in this case. This is the only example of a ship having such a stern tube which

has come under my personal observation, and perhaps in other ships the idea has been more successful.

Even if this patent stern tube fails to carry out the inventor's idea of permitting the renewing of the bearing wood while the shaft is in place, yet the whole design is a marked improvement over the old practice of a one-piece stern tube with brass liner, and the cost of construction of the two is about the same.

J. P. Badenhausen.

Torpedo Boat Trial Trips.

Editor Marine Engineering:

The failure of the torpedo boats in the United States navy to make the original contract speed has received wide attention, and in the report of Lieutenant G. Kaemmerling on a contract trial of the torpedo boat *De Long* the keynote of the situation, I believe, appears to have been struck.

In each case the finished weight of the torpedo boats and destroyers has been in excess of the estimated weight by many tons, and it was found impossible to drive a vessel with this added displacement at the contract speed. The Navy Department, therefore, reduced the requirements to a maintained speed of 24 knots for one hour in the case of the torpedo boats, and 26 knots in the case of the destroyers.

These trials have been conducted with most of the equipment on board, and it is a question whether, in the case of the torpedo boats, this should not be left out altogether, as the theory of the torpedo boat is that it is to be operated from a base of supplies, either afloat or on shore, and that it is not to carry full supplies on board. Lieutenant Kaemmerling says: "A great deal of the requirements put upon torpedo boats to make them absolutely independent must eliminate what has generally been considered the first requirement of the torpedo boat—namely, speed. Should independent action be required for any boat removed from the base, such hardships as would ensue from the lack of heavy bathtubs, marble-slab wash basins, various subdivided officers' quarters, all fitted with wood trimmings, a heavy cooking range, and other heavy equipment in galley and elsewhere, could be dispensed with and without unbearable inconvenience under campaign conditions. To sum up, a torpedo boat should be constructed to operate *from* a base, and not be equipped similarly to a cruiser."

If it is necessary to put this heavy equipment on board, let the torpedo boat first have her trial run and her record of speed established without these unnecessary weights. Then this equipment could be added to make her comfortable for the officers on board in times of peace.

This is such an important topic to builders of torpedo boats that I feel it should be brought before the readers of Marine Engineering to receive general consideration.

J. W. M.

A Steamboat Fire Story on Mark Twain.

Editor Marine Engineering:

Some months ago you published a story regarding a "donkey" engine on a steamboat, in which some experience of Mark Twain as an "engineer" was given. Perhaps, therefore, your readers will be interested in another story on Mark Twain which is going the rounds.

St. Louis.

Clemens was attached as cub pilot to a steamboat which was bound up stream with a heavy cargo of cotton. At the officers' table the first day out from Natchez, Miss., the talk turned upon what to do in sudden emergencies, and especially in case of fire on a steamer loaded with cotton. Mark Twain, like most of the others, held to the notion that it was the pilot's duty to emulate the now famous Jim Bludso and "hold her nozzle to the bank till the last galoot's ashore."

Among those at the table was the assistant engineer, a young man whose experience of life had taught him to doubt the ability of human nature to carry out the projects of its more boastful moments. He went below at the same time that Mark Twain went aloft, but the two continued to think of the conversation just closed.

The pilot house and engine room of a steamboat are connected, not only with bells for signaling, but with a speaking tube. The mouth of the tube at the upper end is but little larger than the human mouth, but in the engine room it has the shape of a funnel as big as a half-bushel measure. While the assistant engineer was pondering the emergency question he was also wiping off a portion of the machinery with a bunch of cotton waste, and as he reached the mouth of the speaking tube it was the work of but a moment to touch a match to the inflammable material in his hand and thrust it far into the tube.

Mark Twain, alone in the pilot house and still pondering the dire things he had heard about the horrors of burning steamboats, was horrified to see smoke pouring from his end of the speaking tube. There was but one thought in his mind. The boat was on fire. Dropping the wheel, which spun around and around as it left his hand, he grasped the rope by which the big bell was sounded and began pulling like a sexton, at the same time raising his voice in a cry of "Fire! Fire! The boat's afire!" Here the officers of the boat and the passengers are said to have found him, after hurriedly ascertaining that the alarm was false, still valorously determined to "save the ship." The boat, relieved of the rudder's guidance, had in the meanwhile swung around in the current and dashed full speed on a sand bar, from which it required half a day to drag her. And Mark Twain, having lost his nerve, left the river.

Mississippi Cotton Steamer.

Editor Marine Engineering:

I am sending to you herewith a photograph which will be of great interest to those of your readers who have not had experience on the lower Mississippi river. The picture shows the steamboat *Kate Robbins,* which had on board 1,010 bales of cotton. The cotton is piled nine tiers high on the main deck, and there are several bales on the hurricane deck.

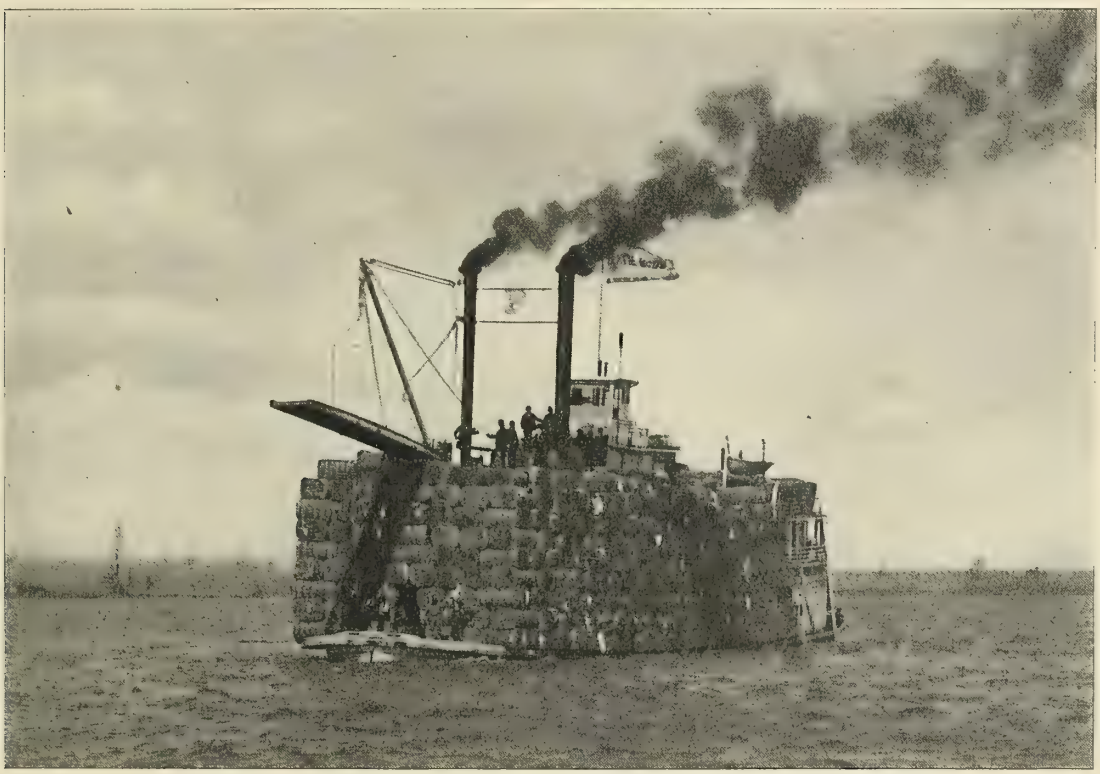
I remember away back in '73 the steamboat *Belle Lee* coming into the levee at New Orleans with cotton piled eleven tiers high, and later, in 1881, the big steamboat *Henry Frank* came down the Mississippi river to New Orleans with the cotton piled twelve tiers high. The number of bales was 9,226, making a somewhat smaller cargo than that of the *Kate Robbins.*

Cotton is put on board the boats on the Mississippi river under difficulties that would seem insurmountable to those engaged in the steamboat freighting business in the North. The *Kate Robbins* on this trip came from the Yazoo river to Vicksburg and picked up her cargo along the banks in bales numbering all the way from one to fifty at each landing. There are no facilities whatever at the so-called landings. The steamer is run into the bank head-on, and the landing stage, which, it will be observed, is hanging at the derrick on the boat, serves as the wharf. The colored roustabouts roll the cotton on board over this stage, and it is only by

employing a large number of men of the don't-care-a-continental style of negro that the cotton is handled at all, and when the river is very high or low the loading of cotton is a very difficult operation. Not infrequently the rain is coming down in torrents, and the roustabouts work in mud half way to their knees.

An important point in connection with cotton cargoes is that the danger of fires is very great. I notice that there is considerable agitation in New Orleans in regard to the danger of the use of fuel oil on board steam vessels, and that the insurance underwriters are leading the agitation. I do not consider fuel oil half as dangerous as cotton. On a cotton-laden boat the bales are piled all round, in every corner and in every place where there is room enough for them. Wood is burned very largely on the tributary river steamers, and great care has to be exercised, for, as you know, cotton is a good deal like gunpowder when a spark touches it.

George L. Norton.



MISSISSIPPI RIVER STEAMBOAT KATE ROBBINS WITH 1010 BALES OF COTTON ON BOARD.

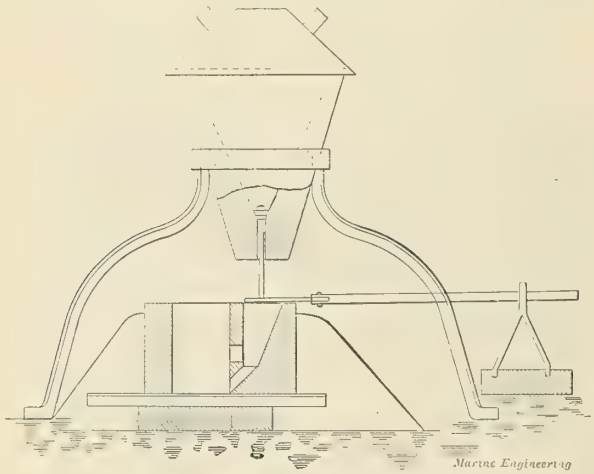
ENGINEERING SPECIALTIES.

Generating Intense Heat Through the Combustion of Aluminum.

Thermit is a metallic mixture discovered in its present state by Dr. Hans Goldschmidt. The compound consists in the main of oxides of metals and pulverized aluminum. The burning of the aluminum in the presence of these metal oxides, and by the oxygen in the metal oxide, generates a heat up to 5,400 degrees Fahrenheit (about 3,000 degrees Centigrade), and at the same time produces the metals in a very high state of purity. This mechanical reaction was known by Wöhler and other experimenters about fifty years ago, but it was left to Dr. Goldschmidt to bring the intense heat generated into practical use and to develop the different processes for the arts.

The Aluminum-Thermit processes can be summarized in, first, using the metal reduced out of the compound; secondly, using the heat generated only; and, third, a combination of both. The first part being purely metallurgical, by which free carbon, pure chromium, manganese, nickel, and other metals are produced, is not directly interesting to the shipbuilder and engineer. The process has been developed for butt welding of any profile or of any weldable material, so that angles, T-bars, and rails of any description are united to make practically one piece. The process is a very quick one, as it takes only about half a minute to weld a street-car rail of about 9 inches height. It makes the welding of angles, etc., possible in places where riveting is not practical. For heating bent stanchions, plates, etc., in order to straighten them, the quick and portable heat of the Thermit will be of great use in a shipyard. Light and heavy work have been done with economy and dispatch by this process, and shafts up to 10 inches in diameter have been successfully welded in one operation. The mending of heavy castings which have been cracked, or have not come out of the mold properly, is one of the features of Thermit. It also enables one to make, without any cupola, small castings, as the Thermit melts out about half its weight in metallic iron, the composition of which can be regulated to suit the case. In any emergency at sea it will prove of great help to the engineer for quick repair.

About the practical application, we might add that the Thermit is produced in special crucibles, which have a lining consisting in the main of magnesia. The Thermit is not inflammable by ordinary means, and a special igniting powder has to be placed upon it and ignited by a wind match in order to start the reaction. Without the igniting powder the Thermit will not burn, even if thrown in the fire or stirred with a red-hot iron. It will keep, if kept dry, indefinitely. There are two ways of emptying the crucible in which the reaction has been completed—one, by pouring it over the rim, and the other, by drawing it off from the bottom. In the first case the slag flows out before the iron, and in the second the iron comes first. As the slag cools far more rapidly than the iron, and deposits a thin layer on the object it touches, the first method of emptying the crucible will be used in those cases where the heat only is to be used, and the adhering of the molten Thermit iron to the object is to be prevented. The second method is applied for joining pipes and tubes, for carrying gases or liquids at high pressure, for welding angle bars and other sections, etc., the result being a clean butt weld. The pipes and other sections can be welded in place, as the Thermit can be applied to them in any position. The weld is no more expensive than a flange for a similar repair.



SECTION OF CRUCIBLE AND MOLD.

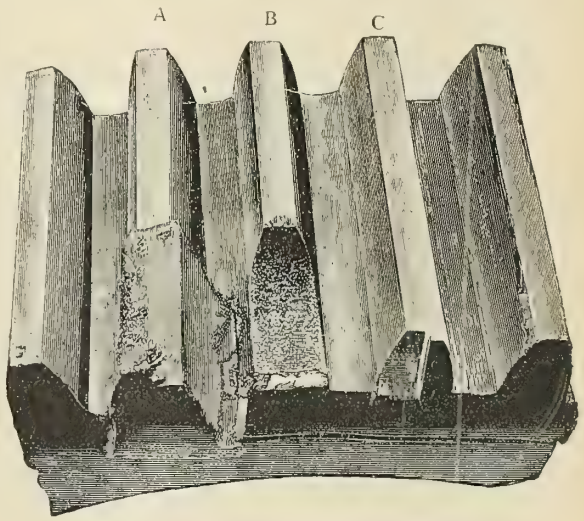
Tapping the Thermit iron first, the iron flows out at such a high temperature that it welds the surface of the metal it comes in contact with, and amalgamates with it. The slag which floats on top of the iron may either be retained in the crucible or else, in cases where it is desirable to hold the heat, can be applied to the weld. This metal has been largely used for welding street-car rails, casting at the same time the strengthening lug around the foot of the rails.

The repairing of faulty castings up to any size is done also by this latter method. In case of a crack, this has to be widened up to about 1-2 to 3-4 of an inch in order to let sufficient of the Thermit iron run in. The superheated metal will soften up the inner walls of the crack and unite with them so perfectly as to make one piece. By this method, many castings that would have to be discarded can be rendered sound and serviceable at a very slight expense, as it is possible to produce by the process an iron or steel of any composition that may be required. The repaired spot on the casting can be made, if necessary, of a structure and quality corresponding to the body. The casting on of broken teeth to gears has been done without even taking the gears out of position.

Where a mild steel casting is wanted in a hurry, it can be readily made by using Thermit with about 20 per cent. of small punchings or small pieces of metalized iron added. This is run into the mold in the usual way, no furnace or cupola being required.

The process is also used to superheat, as well as to render extremely fluid, both steel and cast iron, by adding between one and six per cent. of Thermit, according to requirements.

The Goldschmidt Aluminum-Thermic process includes also the use of titanium, which can be thoroughly incorporated in either steel or iron when in the molten state in the ladle. The titanium not only has the densening effect, but combines with the nitrogen which is contained, more or less, in every metal bath. Titanium makes a close-grained casting, without any bubbles, and castings of complicated design, such as cylinders, slide valves, etc., are especially improved by its use. Usually one-half to one per cent. of the Titanium Thermit is added to cast iron; for steel castings, only one-quarter to one-half of one per cent. is necessary to insure a close-grained material. The larger the castings the better will be the results obtained, and the use of Titanium Thermit is specially recommended for charges of about 1,000 pounds and more.

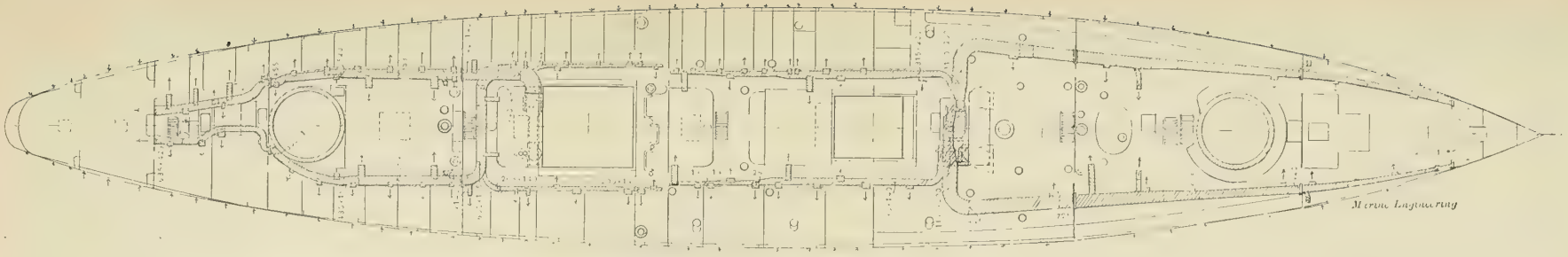


REPAIRING A GEAR WITH THERMIT IRON.

A shows a tooth mended but not machined.
B, broken tooth ready for pouring.
C, tooth repaired and machined.

It might be added that the slag, which consists of practically pure oxide of aluminum, is ground up and used as an abrasive material which is called "Corubin" and used for the same purpose as emery, carborundum, etc.

Any further information will be given by the Allgemeine Thermit Gesellschaft, Essen-Ruhr, Germany, or Mr. Clarence B. Schultz, the American representative of the company, 149 Broadway, New York city.



HEATING AND VENTILATING SYSTEM ON DUTCH CRUISER KONIGIN REGENTES—SINGLE FIGURES ARE THE BREADTHS OF DUCTS IN MILLIMETERS.

Konigin Regentes.

The development of the cruiser during the past few years has been very rapid. These war vessels are becoming more efficient and are better equipped, both for offensive and defensive work. It must be borne in mind that the best ship might soon become almost helpless in battle if it were designed and constructed without due regard to the ventilation of the different compartments which, with the advanced ideas of ship construction, become more numerous and independent. The powder magazines, store rooms, the fire room and coal bunkers must of necessity receive a good supply of pure fresh air, and this necessity increases with the high steam pressure which these modern war ships carry. While the advance made in cruisers has been very marked, the advance made in the heating and ventilating system of these fighting vessels has been even more notable.

For the purpose of illustrating and describing the heating and ventilating plant of a modern war ship, the Dutch Cruiser, H.M.S. *Konigin Regentes*, has been selected. It may be mentioned that the apparatus used to heat and ventilate this ship was furnished by the Buffalo Forge Company, of Buffalo, N. Y., through its London office, and the Ls. N. Alta and Company, of Amsterdam.

The entire heating and ventilating apparatus of this ship is situated on the berth deck and consists of two separate and distinct plants. The larger plant controls the midship and forward portions, while the after portion of the vessel is controlled by the smaller plant. The details of construction of these plants present some interesting features which it will be our purpose to bring out in the following paragraphs.

The forward apparatus, which is situated just aft of the fore-mast, consists of one 70-inch Buffalo Steel Plate exhaust fan, which is direct connected to a 5 horse-power General Electric Company motor, and 2,205 feet of heater, arranged in 5 sections, each section being placed in angle iron frames to prevent its slipping by rolling of the ship. Each steam coil section has 4 rows of staggered 1-inch pipe and is 8 inches wide, 4 feet long and 5 feet 10 inches high. Before leaving the works of the Buffalo Forge Company these coils were tested to 150 pounds per square inch hydrostatic pressure and are to operate under a maximum steam pressure of 120 pounds per square inch or so much less as may be necessary with warmer outside weather. The main supply to the steam receiver is 2 inches, while the drip connections are 1 inch in diameter. These heater sections are encased in a sheet steel heater case connecting the fan to the heaters.

The Buffalo Steel Plate fan has a capacity at the outlets of 10,700 cubic feet at 360 revolutions per minute. The fan is of the regular Buffalo full housing type, stiffened and braced with angle iron after the standard construction.

The ducts which convey the air to the different compartments of the ship are of special construction. They consist of an inner duct of 1-8-inch steel, around which is 1 inch of asbestos lagging, and covering this is another steel duct of quarter-inch metal. Where these ducts pass through water-tight bulkheads a steel gate is so arranged that the duct may be closed immediately, thus rendering the compartment absolutely water-tight, without destroying the heating and ventilating system of any other part of the ship.

The after apparatus, situated just forward of the main mast, consists of a 60-inch full housing Buffalo Steel Plate fan direct connected to a 4 x 3 1-2-inch double double-acting enclosed Buffalo engine. This engine runs at a speed of 400 revolutions per minute, at which speed the fan has a capacity of 6,100 cubic feet of air per minute delivered at the register outlets.

The heater consists of 5 sections, each similar to those of the other heater, and contains 1,365 feet. The main supply to the steam receiver is 1 1-2-inch. When outside conditions require, a pressure of 120 pounds per square inch may be applied to the heaters.

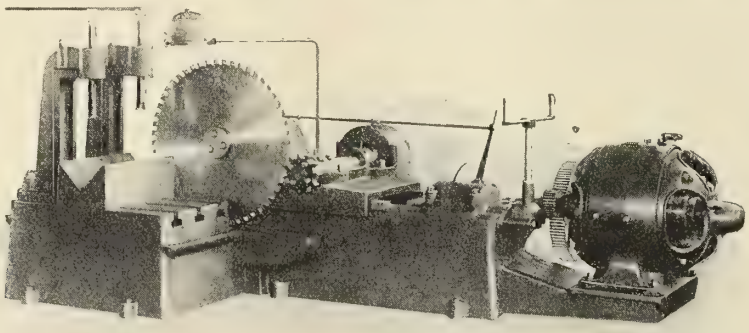
The engine works under any pressure from 120 pounds per square inch to 250 pounds per square inch. The cylinder of this engine was tested to a hydrostatic pressure of 290 pounds.

The heaters thus described are of ample capacity to heat the quantities of air, which the fans are guaranteed to handle and deliver through the 105 registers, to such a degree that the temperature of the ship can be maintained at 72 degrees Fahrenheit, with an outside temperature of 39 degrees Fahrenheit, when all the air is taken from the outside and when the heaters are supplied with a steam pressure of 120 pounds per square inch.

New Metal-Cutting Machines.

Two types of metal-cutting machines have recently been placed on the market by the Q and C Company, which embody many novel features and improvements. One is the Bryant saw, in which the saw blade is driven by a gear or sprocket wheel engaging with the teeth formed on the periphery of the blade, and the other is an arbor-driven saw, where the blade is driven by a central mandrel or arbor. Both types of these saws are made in two styles—cut-off saws and universal saws. In the cut-off type the blade travel is short and the machine is especially designed for cutting off round and square bars, structural shapes, etc. In the universal type the travel of the blade is longer, and the machine is fitted with an upper side table on which the work can be cut off for the entire length of the travel of the saw blade, while they are also arranged with V-blocks and lower tables for cutting bars and shapes.

The illustration herewith shows the motor-driven Bryant cut-off type of machine. When desired the machines are mounted on circular base which may be completely rotated by rack and pinion, this being a very desirable feature where there is not sufficient room for swinging a long beam. Lateral adjustment of side tables is furnished, if required, so that work may be adjusted for cutting after being secured.



A NEW METAL-CUTTING MACHINE, MOTOR-DRIVEN.

Special attention has been given to the arrangement of the tables on all machines, so that work can be placed most advantageously for cutting with a minimum distance of blade travel. The longer side tables are of sufficient length to enable beams, etc., to be properly supported when being cut off at any angle up to 45 degrees and to permit of steel castings within the capacity of the machine being secured to it.

All machines are fitted with the maker's type of frictional automatic feed, which is variable with the machine in motion. The feed is powerful in its action and gives a constant driving force throughout its entire range. The feed wheel is connected to the feed screw by a clutch operated by a lever, by moving which it is engaged or disengaged. In the universal saws the clutch also operates the power return movement with which these machines are fitted. A rod attached to this lever engaging with the carriage operates an automatic stop in both directions. When the clutch is disengaged the carriage can be moved in either direction by hand. The feed nut is solid, 6 inches in length, and bushed with bronze. It is bolted and tongued to the carriage, and can be readily moved without dismantling the machine.

The Bryant saw carriage is in two parts, the sprocket shaft bearing being cast in one piece with the worm-gear hood and is movable 2 1-2 inches toward the axis of the blade, allowing for a wear of 5 inches in its diameter. The sprocket is removable, and all sprockets on these saws are interchangeable and readily replaced. The arbor-driven saw carriage is of good design and exceedingly strong and rigid. All bearings are divided at right angles to the direction of the wear and are of extra large proportions. Both arbor gear and pinion are solid with the shaft, the pinion being hardened. The width of the face is large, and the liberal proportions employed have produced a very rigid and quiet-running machine. All gears in both types of machines are entirely enclosed, avoiding dust and the wear it entails when machines are not advantageously placed. The shears and tables are of strong and rigid design and are provided with oil troughs, so that all lubricant is returned to the central trough underneath the saw blade.

Further information and catalogue can be obtained from the Q & C Company, Western Union Building, Chicago, or 114 Liberty street, New York city.

Torsional Vibrations of Propeller Shafting.

In a recent article which is translated in the *American Society of Naval Engineers,* Mr. Herman Frahm, who is connected with Blohm and Voss, of Hamburg, gives the results of a most interesting series of experiments which he has been conducting. Marine engineers have for many years had to deal with a certain class of shaft fracture the cause of which could not be accounted for. The examination of the line of fracture resembles those caused by twisting action and have pointed toward the existence of considerable twisting moment, but no explanation of their origin has been given. Herr Frahm experiments were for the purpose of examining the extent to which vibrations of a propeller shaft actually occur and to deduce the influence which such vibrations may have upon the reduction of strength of the shafting.

In large steamers the distance between the engine and the propeller, as a rule, is a considerable one, and it is, therefore, obvious that the whole of the shafting.

in consequence of its length, must be regarded as a more or less elastic torsional spring, and not as an absolutely rigid body. This "spring" is kept twisted by the turning movement transmitted from the engine to the propeller. If the propelling power originated from some uniformly-turning machine, as an electric motor or steam turbine, the shafting and propeller would revolve uniformly, assuming the resistance of the propeller not to vary; but the case is very different when the turning force is not constant, but is subject to oscillations such as exist in reciprocating engines.

The following points were investigated: First, the twisting stresses in the shafting had to be found, both in regard to magnitude and variation; secondly, the corresponding variations of speed in the whole system, taking the engine and propeller each by itself, were ascertained.

The apparatus devised consisted of two zinc disks, one placed over the thrust shaft after coupling, the other placed on the propeller shaft coupling. Upon these disks platinum points were brought in contact at stated intervals of time, the points being given also a slightly longitudinal motion, so that the marks traced on the zinc would be spirals. When the points were in contact with the zinc an electric circuit was completed and the current slightly oxidizing the zinc traced a white mark. A timing mechanism made and broke the circuits at the two stations by lifting the platinum points simultaneously at a certain number of times each minute.

The comparison of the two zinc plates gives a complete torsional history of the length of shaft under observation, and from it were drawn curves representing the amount of twist at different intervals of time and the continual vibrations to which the shaft was subjected. Herr Frahm conducted experiments with the shafts of several steamers, and from the data derived from test pieces of the material from which the shafts were made he compared the maximum stresses due to vibrations with the mean stresses due to ordinarily-assumed working loads. The experiments show conclusively that the formulæ ordinarily used in determining the diameter of shafting do not take account of the full torsional stresses, and that shafts of larger diameter should be used. The experiments also point to the advisability of using hollow shafting, increasing the number of cylinders of the engine, or the substitution of the steam turbine as a motive power.

QUERIES AND ANSWERS.

Q. 101.—Suppose that the L. P. crank pin of a compound engine (marine pattern) broke, or, in other words, cracked, so that it would not be safe to run in that condition, what could be done to bring the ship into port, the engine having the air and feed pumps worked off the L. P.? Please let me know the best, safest, and quickest way to repair the same at sea. Hoping that you will oblige and give me a remedy, I remain,

J. E. B.

A.—In the issue of Marine Engineering for September, an answer to another break-down condition was by mistake published in connection with the above, which is therefore reprinted with discussion suited to the circumstances of the case.

The fact that the air and feed pumps are driven off the L. P. crosshead reduces the possible methods of procedure to the following:

(1) We might undertake a repair of the pin sufficiently thorough to carry a moderate load in the L. P. cylinder, and, assuming this possible, proceed with reduced power.

(2) We might undertake a repair of the pin sufficient to enable it to drive the crosshead and with it the pumps, but without allowing steam to enter the L. P. cylinder. In this case the H. P. exhaust must be led to the condenser directly by a connection made for the purpose, or through the L. P. valve chest, the valve having been removed and the ports blocked off.

(3) If not practicable to undertake a repair of the pin itself so as to operate the crosshead, we might still disconnect the connecting rod and swing it clear and then make some form of temporary coupling or connection between the two crank webs so as to transmit the power from the H. P. cylinder. In such case the pumps will be thrown out, the H. P. cylinder must be operated non-condensing, and the boilers must be fed by the auxiliary pump, which we may assume will be available for such duty.

Regarding the repair suggested in (1) and (2), its practicability will depend on the circumstances of the case. If, for example, the crank pin were hollow and a lathe were available, a small pin could be fitted inside the main pin, which might answer the purpose required. If the services of a portable electric motor were available, a hole might be drilled through a solid pin and then bored out to suitable size for repairing in the same way. If no such means were available it would be a hard matter to repair the pin so as to transmit power from the H. P. cylinder and at the same time operate the L. P. crosshead and pumps. If the operation of the pumps be dispensed with, as in (3), the connecting rod may be swung clear, and then, assuming sufficient clearance, the two L. P. crank webs may be bound or lashed together in such manner as to transmit the power developed by the H. P. cylinder. This may be operated non-condensing by breaking the exhaust connection to the L. P. and making a temporary exhaust lead to the deck.

Many details would depend on the special circumstances of the case. Thus, assuming the circulating pump independent, it might be considered worth while in the case of (3) to block the L. P. valve and allow the steam to exhaust through into the condenser, from which it could be drained out for feed pump supply. At the same time the vapor pressure will rise to atmospheric, of course, so that the engine will be operated with an atmospheric exhaust pressure; but the steam will be saved for feed water, and this may be a point of great importance.

Naturally, in a case of this kind, it is impossible to give any exact rules or code of directions, as so much must depend on the secondary circumstances. A break of this kind is always most serious, and without some adequate provision of tools and auxiliary machinery the difficulties of making any kind of a repair will be enormously increased.

Q. 104.—A certain boiler evaporates 20,000 pounds of water per hour from a feed-water temperature of 110 degrees Fah. into steam at 163 pounds gage pressure. If each pound of coal gives up 9,500 B. T. U., how many tons of coal would be used during a voyage of seven days? H. E.

A.—Taking, for round numbers, atmospheric pressure at 15 pounds, the absolute pressure will be 178, and from any standard steam table the temperature of the steam is found to be 371.9 degrees. For all ordinary engineering purposes it will be sufficiently accurate to take as the heat to be supplied per pound of feed water, up to the point of evaporation, the difference between this temperature and 110, the temperature of the incoming feed. This gives 261.9 heat units. Then the same tables give us 850.5 as the latent heat per pound. This must be supplied to complete the vaporization of the water into steam. Adding these, we have 1,112.4 heat units to be supplied per pound of feed water. If, then, we multiply 20,000 by 1,112.4, and this product by 168, the number of hours in seven days, we shall have the total number of heat units required. This divided by 9,500 will give the number of pounds of coal, and this divided by 2,240 will give the number of tons. Expressing this by a formula, we have:

$$\text{Tons} = \frac{20{,}000 \times 1112.4 \times 24 \times 7}{9500 \times 2240}$$

This figures out 175.6 tons.

Instead of the above method, we might have taken from the tables the total heat in one pound of steam above 32 degrees. This is 1,195.4. Then the heat in the feed water above 32 degrees is very closely 110 — 32, or 78. Taking this from 1,195.4, we have 1,117.4 as the heat to be supplied per pound of steam, instead of 1,112.4 as above. This would give 176.4 tons, and is a more accurate method, though the difference is not important for most engineering purposes.

Q. 105.—Diagrams taken from a simple slide-valve engine show a loop formed by the expansion curve extending below the back-pressure line. Another loop is formed by the admission line extending above the steam line. Is the trouble due to a wrong setting of the valve? How may it be remedied, if at all? State all you would do in case you decide that a change is required. E.

A.—The loop formed by the expansion curve indicates too much expansion, and hence presumably too early cut-off. The loop at admission indicates too much compression, and hence too early a closure of the exhaust valve. These, taken together, indicate that in general the valve events occur too early. The remedy for this is to decrease the angular advance of the eccentric, or, in other words, to turn it back toward the crank. This assumes, of course, that the steam and exhaust laps on the valve are somewhere near what they should be. If turning back the eccentric does not properly remedy matters, then the valve itself would require changing; but the details of such change could hardly be given without further information regarding the dimensions of the valve and ports.

Q. 107.—Will you kindly advise me through the columns of your magazine the horse power required to get the highest possible speed out of a yacht, say 75 feet long, using gasoline engines, and what would the speed approximately be for size of boat above mentioned, built for speed and for service along the Atlantic coast? What would be the minimum size of boat to get a speed of 20 miles an hour? Also, what speed approximately could be gotten out of a boat 75 feet long, said boat to use two 85-horse-power gasoline engines, said boat adapted for service along the coast? I would like you to suggest the beam measurement. W. W. W.

A.—The conditions which you propose—viz., the highest attainable speed and service along the Atlantic coast—can hardly be satisfactorily fulfilled in the same boat. If we define the boat to be for generally smooth-water conditions, but without sacrificing a reasonable degree of seaworthiness, then the problem may be worked out somewhat as follows:

Length	75 ft. 0 in.
Beam	8 ft. 0 in.
Mean draft	3 ft. 0 in.
Displacement	20 tons.

Then, for a speed of 20 miles per hour in such a boat, some 275 horse power would be required. In order to install machinery of this capacity, the most careful design throughout, as regards weight, would be required, though these figures are not impossible under the conditions of the best modern practice. It might be even possible, by special careful design, to raise the power somewhat, perhaps to 350 horse power, with an increase in speed to perhaps 22 miles. These conditions are extreme, however, and it must not be forgotten that gasoline engines of this capacity can hardly be said to be yet on the market. The operation of gasoline engines up to 25 horse power per cylinder may be considered as fairly within the limits of present practice in the largest sizes, but the building up of such engines to 200 or 300 horse power is beyond what can fairly be considered as within the limits of assured satisfactory operation with engines of this type. With two 85-horse-power engines, or 170 horse power, such a boat as above specified should make 17 to 18 miles per hour. In the dimensions of the boat above specified, seaworthiness and comfort have been sacrificed to speed. A much more satisfactory boat for most purposes could be made by adding to the beam and making the construction somewhat heavier, giving a boat as follows:

Length	75 ft. 0 in.
Beam	9 ft. 0 in.
Draft	3 ft. 6 in.
Displacement	27 tons.

Such a boat with 170 horse power should make some 16 miles per hour; with 275, some 18 1-2 or 19 might be expected; and with 350, something better than 20 might be expected. It is a question chiefly of the capacity of the builders of gasoline engines to construct machinery in such sizes which shall operate satisfactorily, and on a schedule of weight which shall not be heavier than in the best of present practice. With such machinery it will be relatively a simple matter to produce boats which shall realize the general line of performance indicated above. With increase of beam a still more seaworthy and comfortable craft could be made, but with corresponding decrease in speed.

Q. 108.—Will you please give me a rule for finding the amount of air entering a furnace from a blower fan 6 feet in diameter, 300 revolutions per minute, air duct 3 feet in diameter, air gage shows 1 inch pressure? M. N. D.

A.—For most purposes the following formula will be found sufficiently accurate:

$$V = 4{,}000\, A \sqrt{h}$$

where V is volume in cubic feet per minute, A is area of discharge opening in square feet, and h is draft pressure measured in inches of water. According to this

formula, the volume of air discharged in the case you mention would be: $V = 4{,}000 \times 7.07 \times 1 = 28{,}280$ cubic feet per minute. This assumes that you have a pressure of 1 inch over a discharge opening 3 feet in diameter. In any actual case the discharge will depend somewhat on the condition of the fires, and the draft pressure will also depend somewhat on where it is measured.

Q. 110.—Can you tell me of any eradicating composition that will remove water-proof drawing ink, such as Higgins', from paper without injury to the paper?

A.—We ask our readers who may know of such a composition to please advise us.

TECHNICAL PUBLICATIONS.

A Graphic Method for Solving Certain Questions in Arithmetic or Algebra. By George L. Vose. Van Nostrand Science Series, No. 16, second edition. Size 6 by 3 3-4 inches, pp. 42. Price 50 cents. D. Van Nostrand Company, New York.

Graphical processes provide, so to speak, a bird's-eye view of all relations entering into such problems as they are suited to, and thus make possible a mental grasp of the problem as a whole such as could in no other way be obtained. This feature of graphical processes is well developed and illustrated in the little book under present notice. The author has illustrated the applicability of graphical methods to a large variety of problems which have usually been considered as algebraical only, and has brought out clearly the comprehensive view which these methods give such problems as may be treated in this manner.

We cannot, perhaps, do better than illustrate one class of problems by a single example:

A starts from a town P and walks toward Q, 10 miles away. He starts at the rate of 3 miles per hour and walks 40 minutes, then rests 10 minutes, then walks 2 miles at the rate of 4 miles per hour, then turns around and runs backward 10 minutes at the rate of 6 miles per hour, and. after resting one hour, walks back to P at the rate of 3 1-2 miles per hour. In the meantime B started 1-2 hour after A and walked from Q toward P. He walked steadily at the rate of 3 1-2 miles per hour for 1 1-4 hour, and then at the rate of 2 1-2 miles per hour for 1-2 hour longer. After resting for 40 minutes he then ran forward for 6 minutes at the rate of 5 miles per hour. He then turned about and walked steadily back to Q at the rate of 3 miles per hour. Find the shortest distance which separated A and B, also when they were 6 miles apart, and the location of each man 3 hours after A started.

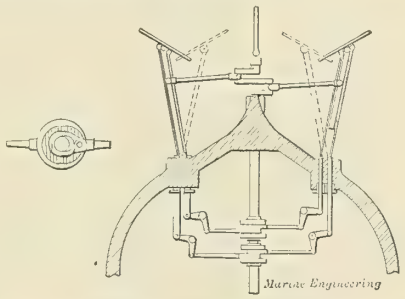
While the solution of such a problem can be reached by analytical means, yet it would prove puzzling to many, and in any event no such bird's-eye view of the relation between A and B as a whole could be obtained as by the graphical method. By such method the solution of the problem becomes as simple as one in direct multiplication or division. Such problems, of course, are not likely to be met with by engineers, but the principles involved may prove of the highest use, and we would recommend a study of these methods to all who are concerned with computations involving time, distance, speed, work performed, rate of work, rate of performance in general, etc.

SELECTED MARINE PATENTS.

705,866. ADJUSTABLE SCREW PROPELLER. EDWARD E. PUNZELT, NORWALK, CONN., ASSIGNOR TO HORACE E. DANN and OSCAR H. BANKS, NORWALK, CONN.

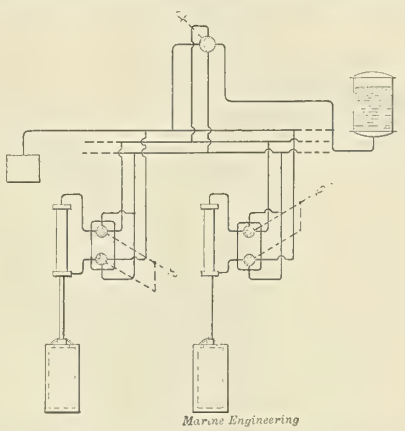
CLAIM.—1. An adjustable screw propeller comprising a hub having threaded bosses, blades having threaded shanks adapted to engage the bosses, set nuts upon the shanks adapted to engage the bosses to lock the blades when turned forward, and means for locking said shanks against movement in the bosses when the propeller is turned backward. Two claims.

706,198. VIBRATING PROPELLER. WILLIAM W. PHARES, NEW YORK, N. Y.



CLAIM 1.—A vibrating propeller comprising two arms hinged at opposite sides of the driving shaft, the cranks upon the driving shaft, the rods connecting the cranks with the arms to vibrate the same, the blades pivoted upon the ends of the arms, and means for tipping the blades when moved in opposite direction. Six claims.

706,471. MEANS FOR OPERATING BULKHEAD DOORS. PAUL HOPPE, BERLIN, GERMANY, ASSIGNOR TO NORDDEUTSCHER LLOYD, BREMEN, GERMANY.



CLAIM.—1. In an arrangement for closing and opening bulkhead doors from a central controlling station, the combination with hydraulic cylinders fitted to the doors, means for operating the doors according as pressure is admitted to either end of said cylinders, and a pressure accumulator, of a pair of pipes connecting the accumulator with the cylinders, a third pipe connecting the cylinders with an exhaust tank, independent pipes connecting said cylinders with said third pipe and controlled by local valves, and means for switching the pressure stored in the accumulator to either of the pair of pipes and connecting the other with the exhaust pipe. Four claims.

706,491. BOW-FACING OAR. RICHARD B. HANSON, BUFFALO, N. Y., ASSIGNOR TO J. HERBERT DIEHL, BUFFALO, N. Y.

Three claims.

706,561. SUBMARINE BOAT. JOHN P. HOLLAND, NEWARK, N. J.

Two claims.

706,578. MARINE ELECTRIC-LIGHT FIXTURE. GEO. L. MARTIN, NEW YORK, N. Y.

Three claims.

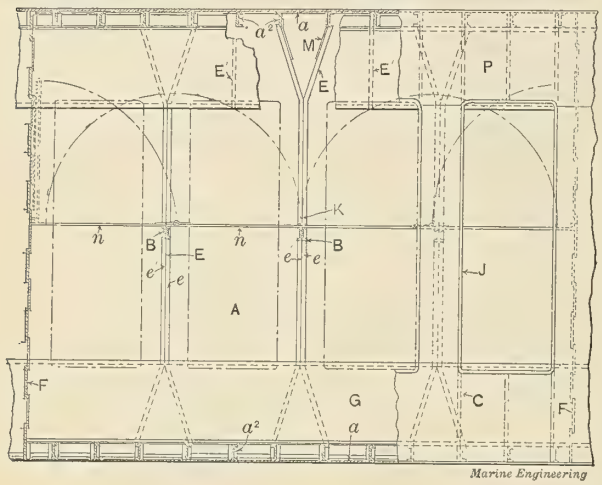
706,707. NIGHT LIFE BUOY. CONRAD C. A. E. WIESE, HAMBURG, GERMANY.

Six claims.

706,708. SHIP CONSTRUCTION. AUGUSTUS B. WOLVIN, DULUTH, MINN.

CLAIM.—4. In ship construction the combination of a hull having internal vertical side-frame members, stanchions rising from points above the center keelson and midway between the hatches, each stanchion consisting of two channel bars riveted together back to back, but having diverging upper ends, transverse spar-deck beams secured to the side-frame members and to the diverging upper ends of the stanchion members, transverse main-deck beams each consisting of a bar *e*, which lies in a transverse groove in the flanges of one of the stanchion members, and is riveted to the stanchion and has its ends bent out

of line and secured to two of said side-frame members, and two bars *e e'* which are butted against the stanchions on opposite sides and extend therefrom toward the sides of the hull and have their ends bent out of line and secured to the side-frame



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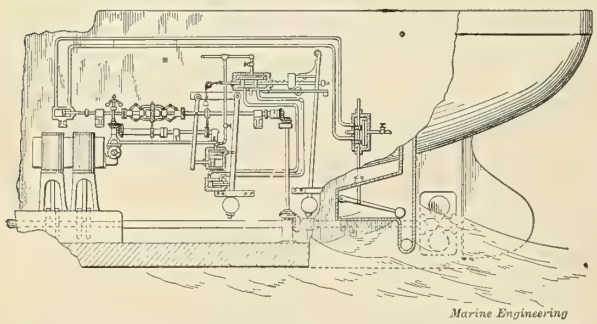
members, gusset plates lying on opposite sides of the stanchion and between the deck-beam members *e e'*, and secured to said deck-beam members, and angle irons fastened to said gusset plates and to the stanchions, substantially as described. Seven claims.

707,038. MARINE-ENGINE GOVERNOR. MARTIN F. VOLKMANN, SANTA MONICA, CAL.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CLAIM.—1. In connection with a marine engine and a propeller shaft driven thereby, a driving shaft operated from the engine, a governor for the steam valve of the engine and normally operated from said driving shaft, and means for speeding the governor upon the rise of the propeller in the water.

2. A marine-engine governor, comprising a governor having connection with the steam-controlling valve of the engine, a driving shaft operated from the engine, a driven shaft operated from the driving shaft, the said driven shaft consisting of two sections, one mounted to rotate on the other, a gear connection between the governor and said section mounted to rotate on the other section, a sprocket wheel loosely mounted on the driving shaft, a driving connection between said sprocket wheel and the last-named member of the driven shaft, clutch devices carried by the driving shaft and adapted for engagement with the sprocket wheel, and means for engaging the clutch devices with said sprocket wheel. Nine claims.

707,293. HYDRAULIC DREDGE. LINDON W. BATES, CHICAGO, ILL.

CLAIM.—1. In combination with a pontoon, a discharge pipe carried thereby; a shore discharge pipe; a flexible connection intermediate said pipes; a pivotal support for the shore discharge pipe, and means for raising and lowering said support. Six claims.

707,371. APPARATUS FOR REMOVING MATERIAL FROM BOATS, ETC. ALFRED M. ACKLIN, PITTSBURG, PA.

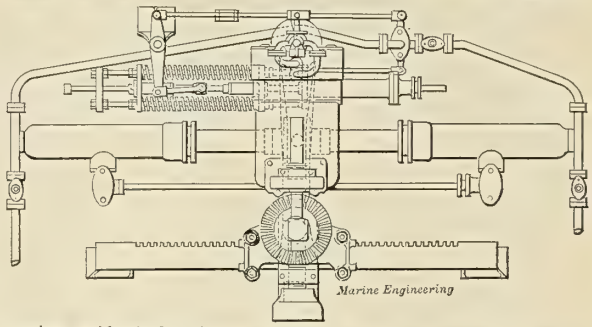
CLAIM.—1. The combination with a boat of a bucket adapted to be lowered and raised to and from the hold of said boat, a deflecting frame, and means connected to said frame for moving the same to tilt the bucket and move the same in a horizontal course to gather the material therein. Four claims.

707,411. MEANS FOR HOUSING PROPELLERS OF SHIPS. JAMES HAMILTON, GLASGOW, SCOTLAND.

CLAIM.—1. A ship having a propeller and shaft adapted to be moved longitudinally, and after portions of the ship in line with the propeller blades, said after portions being shaped to conform with the propeller blades. Three claims.

707,382. STEERING MACHINERY. ANDREW B. BROWN, EDINBURGH, SCOTLAND.

CLAIM.—1. Steering machinery comprising a rudder head, two tiller arms, a motor on one of the arms and hydraulic rams secured to the other arm, hydraulic cylinders for the rams, said motor arm having a slotted end, a carriage in said slotted end, a pinion and shaft carried by said carriage and a rack secured to the deck engaged by the pinion, a shaft actuated by the motor and movable radially on the tiller arm and gearing con-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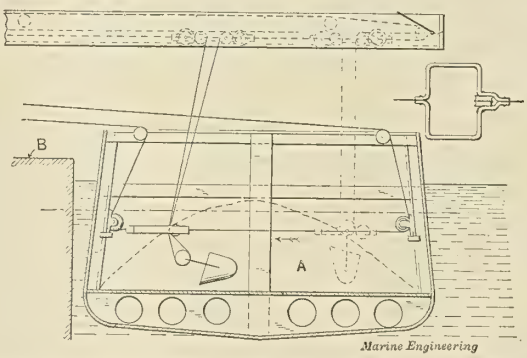
necting said shaft with the pinion shaft, substantially as described. Ten claims.

707,491. APPARATUS FOR REMOVING MATERIALS FROM BOATS, ETC. ALFRED M. ACKLIN, PITTSBURG, PA.

Nineteen claims.



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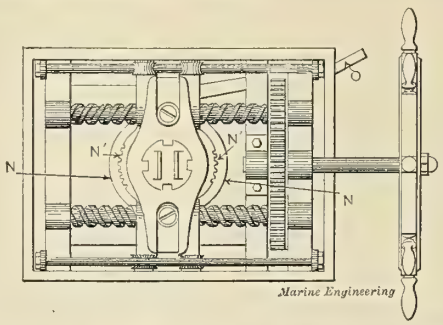
707,492. APPARATUS FOR REMOVING MATERIALS FROM BOATS, ETC. ALFRED M. ACKLIN, PITTSBURG, PA.

Seventeen claims.

707,600. ENDLESS PROPELLER. ADAM KUENTZ, COLBY, WIS.

CLAIM.—1. An endless carrier provided with folding paddles having extensions and a guard arranged parallel with and immediately below the upper portion of the said carrier for the aforementioned extensions of the paddles to travel upon to hold the paddles folded, substantially as and for the purpose set forth. Six claims.

707,607. SHIP'S STEERING APPARATUS. MAURICE E. LOWELL, BEVERLY, MASS.



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CLAIM.—1. In a ship's steering apparatus, a rudder post having secured to it a toothed ring *M*, in combination with pivoted levers, *N*, *N*, having toothed inner surfaces adapted to be interlocked with said toothed ring, a pivoted brake lever *O*, connected to the levers *N N*, as described, and means for adjusting and securing said brake lever in position. Two claims.

707,727. STEAM TURBINE. RICHARD SCHULZ, BERLIN, GERMANY.

Nine claims.

Trial of Swedish Destroyer.—The Swedish torpedo-boat destroyer *Mode*, built by Yarrow and Co., Limited, London, made an average of 32.428 knots speed during a three-hour run. The other means were: Steam pressure, 240 pounds; first receiver, 72 pounds; second receiver, 15 pounds; vacuum, 21 inches; air pressure, 1.5 inches; revolutions, 421.4.

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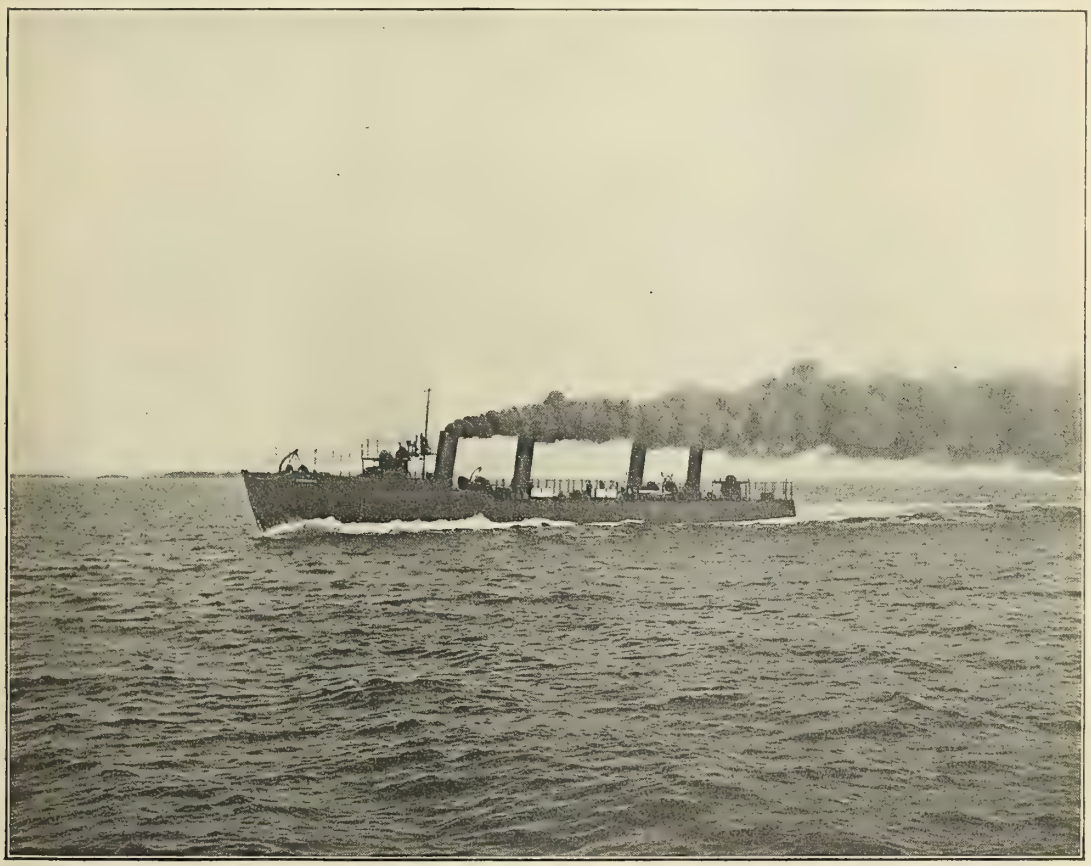
Vol. 7. NEW YORK, NOVEMBER, 1902. No. 11.

TRIALS OF THE UNITED STATES TORPEDO-BOAT DESTROYERS BAINBRIDGE, BARRY, AND CHAUNCEY.

The three torpedo-boat destroyers *Bainbridge, Barry,* and *Chauncey,* which were built by the Neafie and Levy Ship and Engine Building Company, of Philadelphia, Pa., have all successfully passed their acceptance trials and are about to be delivered to the Government at the League Island Navy Yard. These three destroyers are from the same general plans and specifications furnished by the Navy Department, and are identical with the two destroyers built by the William R. Trigg Company and the three recently completed at the Union Iron Works. Each vessel has twin screws, driven by four-cylinder, triple-expansion engines, indicating 8,000 I.H.P.

The original contract was for a speed of 29 knots on a displacement of 420 tons; but as both machinery and hull work went considerably above this, a special Board was appointed, who examined the boats and recommended that the trials be modified. The vessels are 460 tons displacement, and the new requirements were that each should run a progressive speed trial and standardize the propellers to a speed of at least 28 knots, and run one hour at a speed of 26 knots, with full contract weights on board and complete in every respect. Under these conditions the boats easily fulfilled the requirements.



U. S. TORPEDO-BOAT DESTROYER BAINBRIDGE WHILE ON TRIAL MAKING 29 KNOTS.

(Copyright, 1902, Groeninger, Baltimore, Md.)

The following tables give the results and conditions of the trials. The pressures recorded are the average from the mean of three readings, taken during each run by the Board. The number of turns are the mean averages per minute, and were recorded by counters placed on deck, which, at a signal, were thrown in gear at the moment of entering the course, and out of gear at the finish of each run. The difference in time and slip are for the runs with and against the tide. The Board required that four double runs be made over

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OFFICIAL STANDARDIZATION TRIALS: BARREN ISLAND COURSE.

Bainbridge: Displacement 460 tons at start, safety valves lifted at 235 pounds. September 11, 1902.

Runs.	Time on Course.	Revs. per M. Mean.	Steam at Eng.	Air Pressure in Fire Room.		Speed, Knots.	Mean Speed.	Slip.	Mean Slip.
	M. S.		Lbs.	For'd.	Aft.				
1 South..	2 31.5	270.1	135	¾ in.	¾ in.	23.76		15.81	
1 North..	2 36.2	271.4	135	¾ "	1 "	23.05	23.41	18.73	17.27
2 South..	2 16.2	301.7	180	2 ins.	1¾ ins.	26.43		16.17	
2 North..	2 23.5	299.6	176	1¾ "	1¾ "	25.08	25.76	19.85	18 01
3 South..	2 13	312.9	195	4 "	2¾ "	27.06		17.19	
3 North..	2 16.2	313.5	198	2 "	3¾ "	26 43	26.75	19.30	18 25
4 South..	2 04.5	334.4	230	6 "	6¾ "	28.82		17.49	
4 North..	2 08.2	334.7	230	6 "	7¼ "	28.08	28.45	19.69	18.59

Barry: Displacement 461.6 tons at start. August 27, 1902.

Runs.	Time on Course.	Revs. per M. Mean.	Steam at Eng.	Air Pressure in Fire Room.		Speed, Knots.	Mean Speed.	Slip.	Mean Slip.
	M. S.		Lbs.	For'd.	Aft.				
1 South..	2 32.1	254	125	1½ ins.	1¾ ins.	23.67		16.58	
1 North..	2 38	251	120	⅞ in.	¼ in.	22.78	23.22	21.95	19.26
2 South..	2 15.3	287	180	2¾ ins.	2¾ ins.	26.61		17.04	
2 North..	2 26.1	284.6	180	2¾ "	2¾ "	24.64	25.62	22 50	19.27
3 South..	2 10.2	300.5	212	6 "	2 "	27.65		17.65	
3 North..	2 16.2	306.8	210	6 "	3 "	26.43	27.04	23 09	20.32
4 South..	2 07	321	240	7¼ "	7 "	28.35		21.25	
4 North..	2 09	327	240	7½ "	7 "	27.91	28 13	23 62	22.43*

*A slight derangement in steering gear on 4th run reduced the speed and increased slip.

Chauncey: Displacement 463 tons at start. August 12, 1902.

Runs.	Time on Course.	Revs. per M. Mean.	Steam at Eng.	Air Pressure in Fire Room.		Speed, Knots.	Mean Speed.	Slip.	Mean Slip.
	M. S.		Lbs.	For'd.	Aft.				
1 South..	2 33.1	256.7	135	⅞ in.	¼ in.	23.5		16.75	
1 North..	2 43.2	254.4	130	⅞ "	⅜ "	22.07	22.79	21.16	18 95
2 South..	2 22	277.5	175	1½ ins.	2¼ ins	25.35		17.00	
2 North..	2 27.4	284.2	172	1½ "	2¼ "	24.42	24.88	21.93	19,46
3 South..	2 08	312.3	220	4¼ "	4¼ "	28 13		20.58	
3 North..	2 13.7	313.4	221	3 "	3 "	26.93	27.53	21.99	21.28
4 South..	2 02	328.8	248	8 "	8½ "	29 51		18.49	
4 North..	2 09.6	326.3	240	7 "	7½ "	27.77	28.64	22.65	20.57

NAME—Chauncey. NATIONALITY—American. BUILDER—Neafie and Levy Co.

TYPE—Torpedo-boat Destroyer. LAUNCHED—1901. OWNER—U. S. Government.

Length over all	250 ft. 3 ins.
Beam, extreme	23 " 9 "
Depth	14 " 3 "
Draft, forward	5 " 6 "
" aft	8 " 9 "
Displacement, trial	463 tons
Block coef	.41
Midship coef	.77
Prism. "	.53
Bunker capacity	212 tons
Propellers, number	2
No. of blades	3
Diameter	8 ft.
Pitch	11 ft. 2 ins.
Pitch ratio	1.4
Developed area	24.2
Ratio "	.478
Tons per inch, L. W. L.	10.05
Cent. of grav. of L. W. L. aft	7.5 ft.
Cent. of buoy. above bot. of keel	4.6 "
Number of frames	140
Trials.	
R. P. M.	328.8
I. H. P.	7,800
Speed.	28.7 knots
Slip	20½ per cent.
Boiler pressure	250 lbs.
Coal per I. H. P.	2.5 lbs.

NAME—Chauncey. NATIONALITY—American. BUILDER—Neafie and Levy Co.

TYPE—Torpedo-boat Destroyer. LAUNCHED—1901. OWNER—U. S. Government.

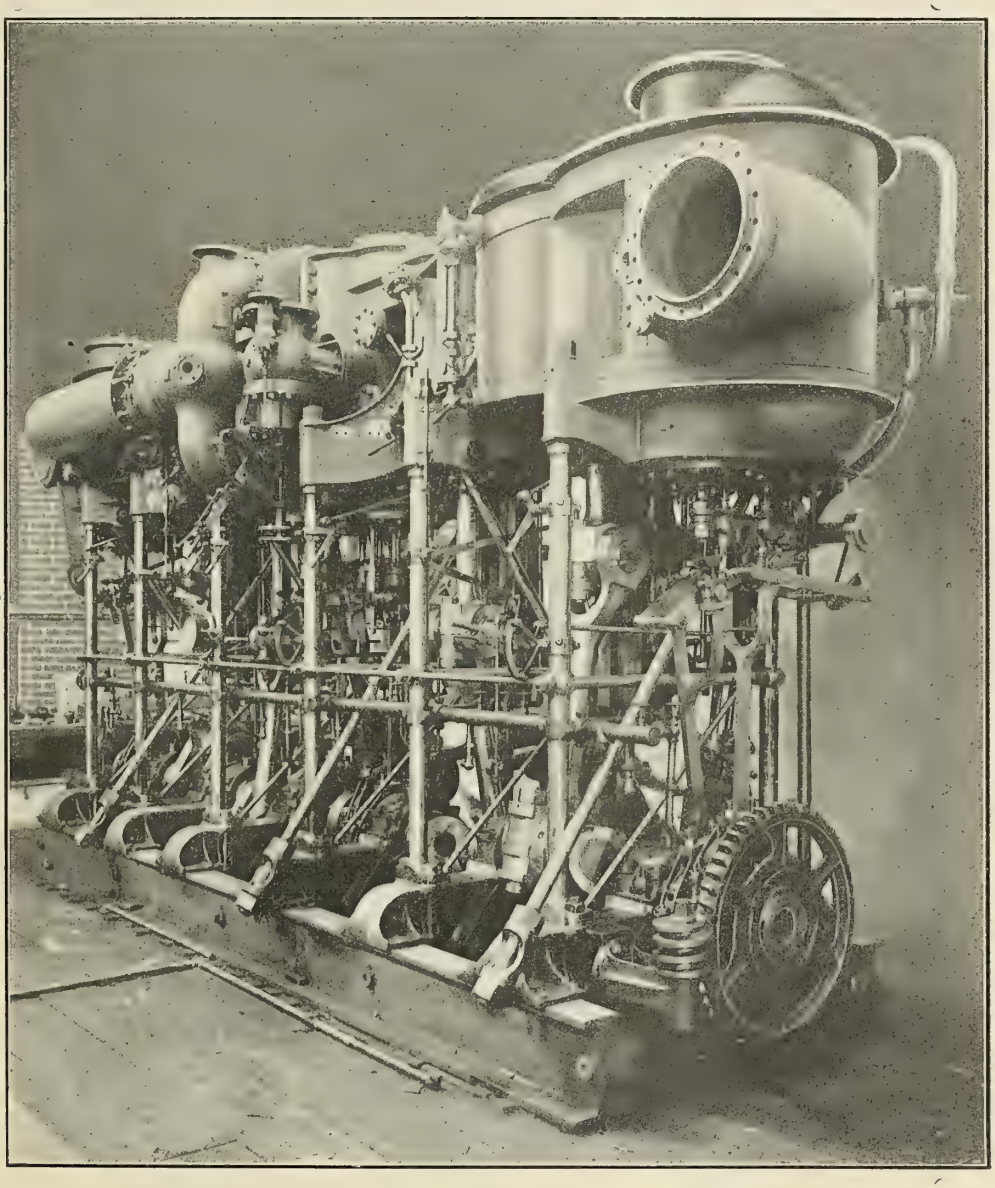
Engines, number	2
Type	four-cylinder, triple
Cylinder diam.	20½, 32, 38, 38 ins.
Valves	double-ported piston.
Sizes	one 12 in., two 13-in., four 13-in.
Stroke	22 ins.
Designed R. P. M	325
" I. H. P.	8,000
" speed	28 knots
Area condens. surf.	6,040 sq ft.
" thrust "	1,128 sq. ins.
Diam. pis. rod	Out, 4¼ in.; hole, 2¾ ins.
" con. "	Up, 3⅞ ins.; low, 4⅝ "
" " "	Hole, 2⅛ ins.
Length " "	46¾ ins.
Diam. crank pin	Out., 8½ ins.; hole, 4¾ "
Length " "	12 "
Diam. crank shaft	Out, 8½ ins.; hole, 4¾ "
Length main jour.	13, 14, 12, 13, 9½, 9½, 9¼ "
Area guide surf., each	176 sq ins.
Length cr. hd. pin	8½
Diam. " " "	Out., 5¼ ins.; hole, 2½ ins.
Air-Pump.	
Type	Double-Acting Bailey
Diameter	12 ins.
Stroke	6 ins.
Volume	169.6 cu. "
Boilers, number of	4
Pressure	250 lbs.
Type	Thornycroft-Daring
Length casing	10 ft. 2 ins.
Breadth	15 " 6 "
Height	10 " 2 "
Length of grates	7 ft.
G. S.	315 sq ft.
H. S.	17,768 sq ft.
Draft	6 to 7 ins water
Fans	four, 54 ins in diam. by 14 ins wide
H. S. ÷ G. S.	56 4
H. S. ÷ I. H. P.	2 22
I. H. P. ÷ G. S.	25.4
Weights.	
Engine, total	196,000 lbs.
" per I. H. P.	24.5 "
Boilers, dry	222,000 "
Boilers, total	236,000 "
" per I. H. P.	29.5 "
Machinery, total	418.000 "
" per I. H. P.	52.3 "

the measured course at speeds as near as possible to 22, 25, 27, and not less than 28 knots. The throttles were carried wide open and the steam pressure in the boilers regulated to suit the different speeds.

The method of determining the revolutions required for the true speed of 26 knots an hour was by plotting a curve, the mean of the two curves drawn for the speed and revolution with and against the tide. It was then found that the *Bainbridge* would have to make 303 mean average turns; the *Barry*, 292; and the *Chauncey*, 294 turns. This difference is on account of the variation of the pitch of the propellers. On the one-hour trial no attempt was made for high speed. Ten turns in excess of the requirements, or .9 of a knot on a steam pressure of 200 pounds and an air pressure in the fire rooms of about 3 1-2 inches, were attained. "Run of the mine" Pocahontas coal was used on all the trials. The crew came from the builders' yard, and the boilers were fired by steamship firemen secured from New York. The crew, all told, numbered forty-eight men.

As several long runs had to be made to and from the trial course, there was a good chance of testing the sea-going qualities of the boats and also of learning the coal consumption. At a speed of 12 knots, and with natural draft, about 1,650 pounds of coal were burned per hour with two boilers in service. With the same number of boilers and 1-inch air pressure, a speed of 18 knots was attained on 1 1-2 tons of coal.

The three vessels were built side by side on the stocks, as shown in the accompanying engraving, and were launched complete with steam up. The boilers were tested with both water and steam after they were placed on board, and the engines and piping were also tested before covering. After each vessel had been launched the shafting was carefully tried, and no



ONE OF THE FOUR-CYLINDER TRIPLE-EXPANSION ENGINES, U. S. TORPEDO BOAT CHAUNCEY.

change from the original line was found. The bearings ran well on all the trials and were afterward lifted for inspection by the chief officer of the Trial Board. Two hours after the *Barry* was launched, which time was required to remove the packing from under her, she proceeded down the river fifteen miles and back. Everything worked satisfactorily, and a few days after this the vessel went down the river again on half power. She then proceeded to the trial course in Chesapeake Bay, and had one run of forty minutes before undertaking her official trials, which were passed successfully.

THREE TORPEDO-BOAT DESTROYERS WHILE BUILDING AT THE YARD OF NEAFIE AND LEVY SHIP AND ENGINE BUILDING COMPANY.

THE CARD INDEX SYSTEM.

The card index system is becoming very popular with engineers and draftsmen, and it may soon take the place of the once necessary note book. Its flexibility and the readiness with which it is kept up to date are the leading features of attraction. The author has developed one that has proved practical and useful, and he has grown so enthusiastic over it that he believes a description of the leading features may be of interest to others who are desirous of compiling information in a convenient form.

The cards used are 4 inches by 5 inches, both blank and plain ruled. They are indexed very simply, according to subject only, with few cross references. To begin with, formulæ for calculation are copied and filed—not standard, well-known formulæ, as for beams, or Lloyds, etc., but such useful formulæ as one comes across in good technical reading, or such as one may derive himself. The source of all data should always be given, as data without positive authority for its existence will not be recognized in reputable engineering offices.

Sketches form another important division of the card index system. They may be freehand or scale drawings. In this work the usual mistake is to accumulate too much useless matter on the start. No sketch should be filed without it has some special or standard point of merit. It is a mistake to sketch everything haphazard. In connection with this the kodak may be used with valuable results. Use a plate or film the same size as the card. The 4-inch by 5-inch is advised for both. Machinery, ships, details, large drawings, methods of hoisting, and interesting accidents can be photographed on the spot, and the print filed with the data on the back. With this data should be given the number and other information necessary to find the negative. Velox is the best for all-around work of this kind. A sheet or two of good blue-print paper may be cut up into cards, and on this prints can be made from parts of large drawings which have special features desirable to note. Indicator cards may be taken on thin paper and then printed through on these, to save for future reference. The scales must be measured off and marked before printing, as the blue-print paper will shrink and stretch.

Many times one wishes to keep clippings of drawings or engravings of machinery, fixtures, inventions, etc. One hesitates to spoil his file of papers, and yet hates to buy extra papers to cut up. The following works beautifully: Make a solution of alcohol saturated with clean sal soda, then add one-tenth, by measurement, of fine, clean, powdered shellac. Spread this solution on the picture desired. Lay a blank card over it and rub the card with a warm flatiron. Then carefully lift the card. The picture will be beautifully transferred to the card, with still enough left on the magazine to be

perfectly clear. Of course it will be reversed, but this seldom matters. By these methods full and very complete data, with photos, etc., may be filed of the building of a ship, her engines, boilers, propellers, tests, materials, and appearance. The full data of her trial may also be filed systematically and clearly.

One can file, for comparison, data pertaining to valve gear, cards, combined cards, various curves, the more abstruse and mathematical data pertaining to a particular piece of machinery, that the designer may have all this to refer to when he has occasion to make comparisons.

Also cards may be cut from cross-section paper, and in miniature these will serve to preserve the curves used in calculations. For instance, the curve of thrust for a given ship is useful to have for comparison with the next ship in order to judge what has been attained in a comparative way.

When one is sightseeing he should be supplied with sketchbook and rule or kodak. Of course reference is made to sightseeing in the machinery line only, as one of the best sources of information for the card system is what a person sees and hears. For instance, the writer once inspected and was much interested in a forced-draft system which an ingenious mill foreman had gotten up to assist in burning wet redwood sawdust and slabs. The information and remarks were put on one card, a sketch of the tuyeres on another, a skeleton sketch of the piping and blower on a third, and a photograph of the plant on a fourth. From these four cards the plant could be successfully installed by one who had never seen it.

Of equal, if not greater, importance than what an engineer sees and experiences is what he reads. His periodicals, his books, the literature from his various societies, and the great number of handsome, instructive catalogues will all furnish valuable material. For example, the various formulæ for flat plates to resist pressure, the standard forms of Corliss gears with drawings, sketches of different systems of oil burning and data, valuable tests of bursting point of flywheels, etc.

The value of advertisements is underestimated by many. Recently an engineer, in looking in his card system, saw "How to condense with a small amount of water, new idea." Looking up the reference, he found that it was the now well-known system of surface condensing with a spray and blower. The idea he had seen in an advertisement, and it happened to particularly suit the wants of his client, and a neat compensation was his reward.

It can be readily seen that such a card system would take the place of the pocket or note book. It is not an index system, for it is the note book in itself and never ceases to grow.

As to methods of indexing, cross references should be avoided except where especially desirable. It is best to arrange according to name of largest conglomeration, as "Steamship *Korea*" or "Waterside Power Station." Then if a man wants, for instance, a good design for 80-inch cast-steel steam piston, instead of looking in "Pistons," he looks under some job such as would be likely to have a piston of desirable design. But if he finds a piston in his travels or readings of peculiar or special merit, then it, with sketch and data, is filed under head of "Piston."

Cross-section paper cut to card size occupies no mean place in the card index. Curves can be reproduced or data of a run can be thus preserved. Suppose the records of a station are kept on the card index system. A card is marked every thirty minutes with the point showing graphically the load, and another point showing the coal or oil consumed. At the end of the watch the cards are turned in to the clerk, who traces the load curve in black and the fuel curve in red, and it is then filed away for reference, comparison, or used by the consulting engineer for comparison with other stations. This scheme can be carried as far into complex detail as may be desired; and the possibilities of the card system are in evidence at their best in just such a place.

The cards are best filed in a fixed cabinet, many ingenious varieties of which are handled by well-known companies.

The first question in a beginner's mind is, "Shall I retain my note book?" It is not necessary if the card system is carefully classified and labeled envelopes used. These envelopes for indexing can be gotten of any card index company. In them can be kept stray clippings, articles, negatives, samples of emery, polishing compounds, chemical tests, filings, scale, sediment, etc. They should be the same size as the cards and can be filed right among them.

It is well to have a little morocco case that will neatly hold and protect at least fifty cards, in order that those relating to any given subject or group of subjects may be carried in the pocket for reference when required. Suppose one is installing or figuring to install a centrifugal pump, and has to see the pump or talk with the customer frequently. It would be well to have his available data and former estimates in his pocket, that he might drop into a quiet corner and consult them if perplexed. Memory cannot be absolute.

Added to this we now have the Card Index Magazine, which may grow enormously. It is mailed to us, with data of ships and engines printed, all ready to file for future reference.

Large drawings in the engineer's office must be classified with the books and periodicals of which the cards are the index. They can be filed according to any of the approved drawing-room and library systems; but the object of the card system ends with the ability to ease the burden on memory, systematize technical data, constantly eliminate that which is obsolete and be able to utilize the remainder at a moment's notice and to the best advantage.

Battleship Plant.—The electrical equipment of the battleship *Connecticut* consists of eight 100-K. W. steam-driven generating sets of 125 volts. There will be six electrically-driven generators to supply current to the turret-turning motors; eleven hundred electric fixtures complete; ten enclosed arc lamps for engine and boiler rooms; six 30-inch searchlights; two truck lights; electric night signaling sets; divers' lamps, ventilating sets, etc.

GAS ENGINES AND THEIR TROUBLES.—VI.

BY E. W. ROBERTS.

Installation.

There are quite a number of different ways of installing a gas engine in a boat, although the same general plan is usually followed. This is to place the engine either aft or amidships, with the fuel tank in the bow, so that the gasoline flows by gravity to a vaporizer placed as low down as possible near the engine. There are variations of this method, induced by some special arrangement of the interior or by the purpose for which the boat is intended. Sometimes, for instance, the gasoline tank is placed in the stern just under the after deck, and again it is placed beneath the floor in an air-tight tank and air pressure employed to raise the fuel to the vaporizer. In the smaller craft the engine is usually placed clear aft and at a considerable inclination. The latest practice, however, for boats of 30 feet or over using heavy engines, is to place them amidships, while in some cases the engines have been placed clear forward, as, for instance, in some of the later speed launches.

Taking first the case of installation as ordinarily employed and shown in Fig. 25, the general scheme is indicated for a small boat in which a single-cylinder, four-cycle engine is installed amidships. The plan shown is that for a boat of about 20 feet length by 5 feet 3 inches beam, with a 5-inch by 6-inch engine. Starting at the bow, the gasoline tank, with a capacity for about twenty gallons, is placed under the forward seat or deck, as the case may be. This tank should be of galvanized iron or copper, carefully soldered, and tested with gasoline to see that there are no leaks. In the top of the tank is placed a filling plug of brass, and in this plug should be drilled, according to the usual practice, a hole about 1-8 inch diameter as a vent. While it is the usual practice to put a vent in the plug, the writer believes it unnecessary, as he has run gasoline engines with tightly-closed tanks, without experiencing any trouble whatever. If the tank is tied by rods passing straight through it horizontally both forward and athwartships and about half way up the tank, it will stiffen it and avoid the snapping which is sometimes experienced with thin metal. These rods should be riveted on the outside and the hole carefully soldered. These rods will also avoid bursting the tank from rise of pressure due to overheating and consequent generation of vapor. In extremely hot climates, as, for instance, in Australia, it might be necessary to use a vent in order to prevent bursting of the tank. The space in which the tank is placed should be well ventilated, in order that all gasoline vapor escaping from the tank may be carried away and not allowed to accumulate.

From the gasoline tank the liquid is carried to the engine through a valve, as indicated, the connection to the tank being made at least 1-2 inch from the bottom in order to prevent any sediment which may find its way into the tank from getting into the pipe. The bottom of the tank, as shown in the figure, should have a slight inclination aft, so that it may be well drained. To the valve should be attached a lead pipe leading to the engine, and the joint between the pipe and the valve should be a good wipe joint, made by an experienced plumber, as should also be the connection at the vaporizer. Lead pipe is preferable for several reasons. It is quite easy to bend it in and around corners, and bending it is not likely to produce a leak, as would be the case with iron pipe. Again, iron pipe is very apt to have cracks which do not always develop when first connected. It is exceedingly important that leaks into enclosed spaces of the boat should be avoided. These leaks occasion a collection of gasoline vapor mixed with air, which makes a dangerous explosive. With some builders it is the practice to enclose the lead pipe in an outer casing of iron pipe, thus making it more secure against leakage. Placing the vaporizer low avoids the use of a pump, although the gasoline pump is sometimes employed with a vaporizer and an auxiliary reservoir near the top of the engine.

There are two very important points to consider in building the foundation for the engine. In the first place, the engine must be firmly attached to the foundation and the foundation to the boat, so that it will not be easily torn loose. Again, the strain should be distributed over a large surface, in order to avoid swaying of the engine and a racking strain upon the boat. A very common method is to place the engine upon two sister keelsons, which extend quite a distance fore and aft and are firmly braced. In a comparatively large and stanchly-built craft this method is a good one, especially if the engine is bolted to the foundation by a plate at the bottom of the base. It is quite common practice to bolt an engine to the sister keelsons with lag screws, but this method the writer does not consider a good one, as the wood is likely to rot around the lag screws, allowing them to pull out. Wherever the construction of the foundation will allow it, through bolts should be employed, with washers of a generous size wherever the bolt is drawn against wood.

The engine shown in the figure is bolted to the foundation by means of lugs at the center of the crank case, in order to save the mass of metal usually required for a foundation base. As the bolt is a light one, the four floor beams indicated are first laid, and to these are bolted two stout oak sills, thus distributing the weight over a considerable portion of the bottom. If these sills are well put in, no side braces, as are sometimes used, will be found necessary. Every marine engine should be provided with a water pump for forcing water through the jacket. The water is usually drawn through the bottom near the keel, the end of the suction pipe being covered with a strainer to prevent choking the pump. The pump suction might be also connected with a pipe leading to the bottom of the boat for pumping out the bilge. Each of these suction pipes should be provided with a cock, of which one—the sea cock—is indicated in the figure. The bilge pipe will be found more convenient if it has attached to it a length of rubber hose that may be carried to suck different parts of the boat as may be filled with water. Under no circumstances should the bilge cock and the sea cock be left open when leaving the boat for any length of time. Should both cocks be left open, water is very likely to siphon in from the sea and out through the bilge pipe, swamping the boat.

From the pump the water usually passes to the jacket at a point near the bottom, and thence out through a pipe at the top of the cylinder to an outlet above the

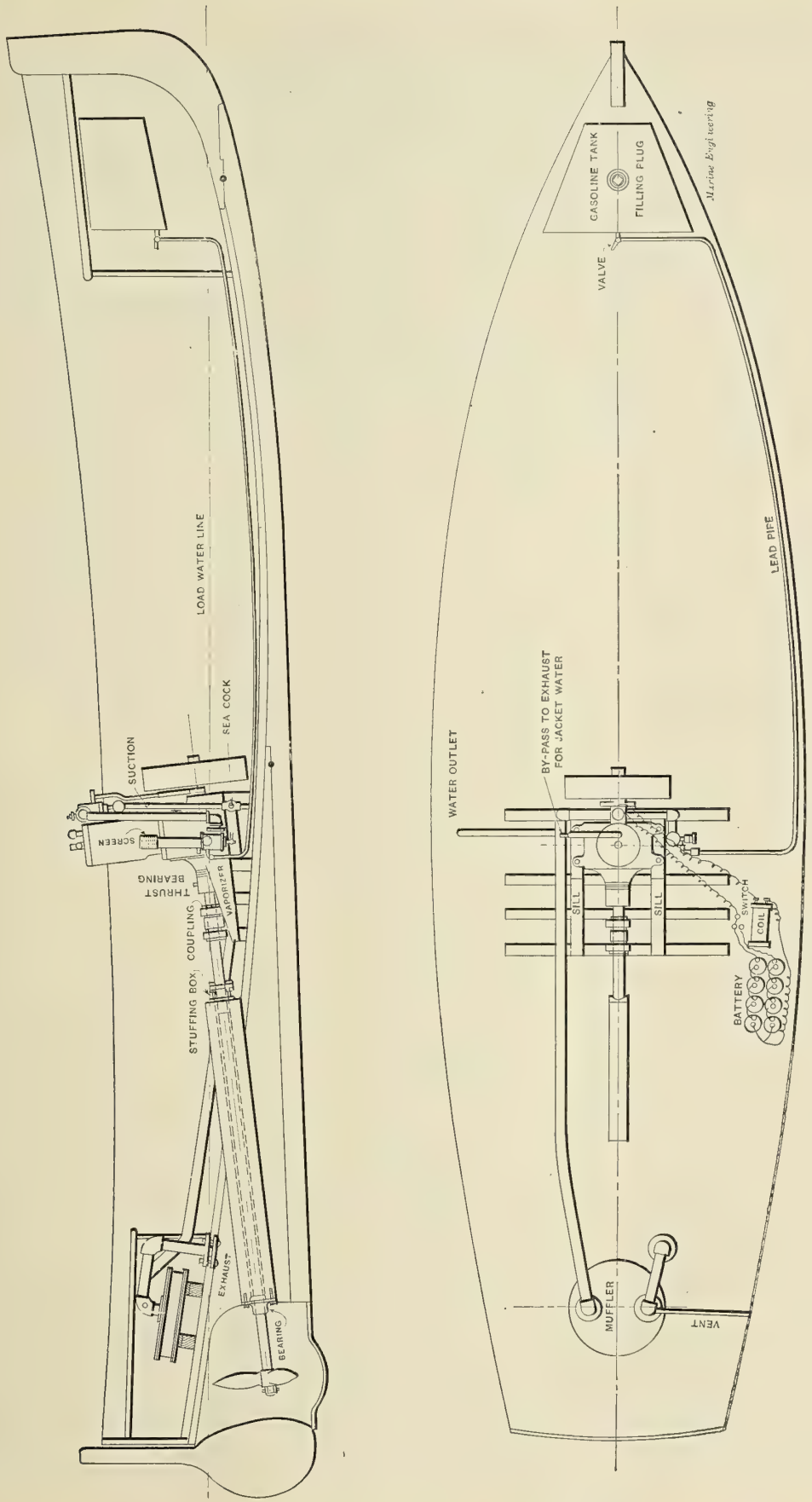


FIG. 25.—ARRANGEMENT OF MACHINERY AND PIPING FOR A GASOLINE LAUNCH.

water line, ordinarily just beneath the top strake. Not always, but quite frequently, a portion of this water is allowed to pass into the muffler, the amount being usually just what the heat of the exhaust will evaporate, and not sufficient to flood the muffler. This water not only keeps the muffler cool, but also assists in reducing the noise by condensing a portion of the exhaust gases.

The plan of connecting up the exhaust pipe shows the latest practice, the muffler in this case being of the shape of a snare drum. There is nothing at all mysterious about this muffler; it is nothing more nor less than an expansion chamber. This particular muffler consists of a cast-iron ring, to each side of which is bolted a flat plate of boiler iron. The entire device is so designed as to withstand a pressure of 100 pounds per square inch in order to provide for explosions that might accidentally take place therein. The shape of the muffler is usually made to conform to the space occupied, and if this is such as to allow of a simple cylinder of extra-heavy stovepipe iron, this will make a very light muffler for a small engine. The exhaust enters at one side of the muffler, as shown, whence it passes downward to a point just below the water line. In order to avoid water being drawn into the muffler from the sea should a vacuum be formed when the engine is stopped, a small vent is run from the muffler to a point above the water line. This vent should always be employed when the exhaust is beneath the water. The reader should note that the under-water exhaust is carried only two or three inches beneath the water surface, otherwise there would be excessive pressure on the engine, thereby reducing its power. This greatly aids in decreasing the noise and also destroys much of the disagreeable odor of the exhaust gases.

Returning to the engine, the connection to the propeller shaft is made with any good form of coupling, a compression coupling being that shown in the illustration. A ball or a roller thrust bearing should be placed immediately back of the main bearing of the engine, and on some engines now on the market this is part of the regular equipment. The propeller shaft passes outward through a shaft log with a good form of stuffing box at one end and a bearing at the other. Practice varies as to which end of the shaft log the stuffing box should be placed, but it will be found most convenient if placed inside the boat. The equipment illustrated in Fig. 25 has the engine coupled directly to a solid propeller without a reversing mechanism. This does very well for a small boat, if it is not used on a crowded waterway. Where a reversing mechanism is in frequent demand, either a reversing propeller or a reversing clutch may be used. Where there is room to spare inside the boat the reversing clutch is to be preferred, as the solid propeller is quite a little more efficient than one with reversible blades. However, when the engine is placed very far aft there is usually no room for a reversing mechanism, and a reversing propeller becomes necessary. In at least one make of two-cycle engine the engine itself is made to reverse by manipulating the spark lead. In this case, of course, no reversing propeller or clutch is necessary.

With large engines having a number of cylinders the latest practice is to place the engine shaft parallel with the keel and to use universal couplings between the engine crank shaft and the propeller shaft. This necessitates at least one pillow block for the inner end of the propeller shaft. If the engine be very large, the thrust bearing is put back of this pillow block, as well as behind the after-engine bearing, the reversing mechanism being placed just aft of the engine.

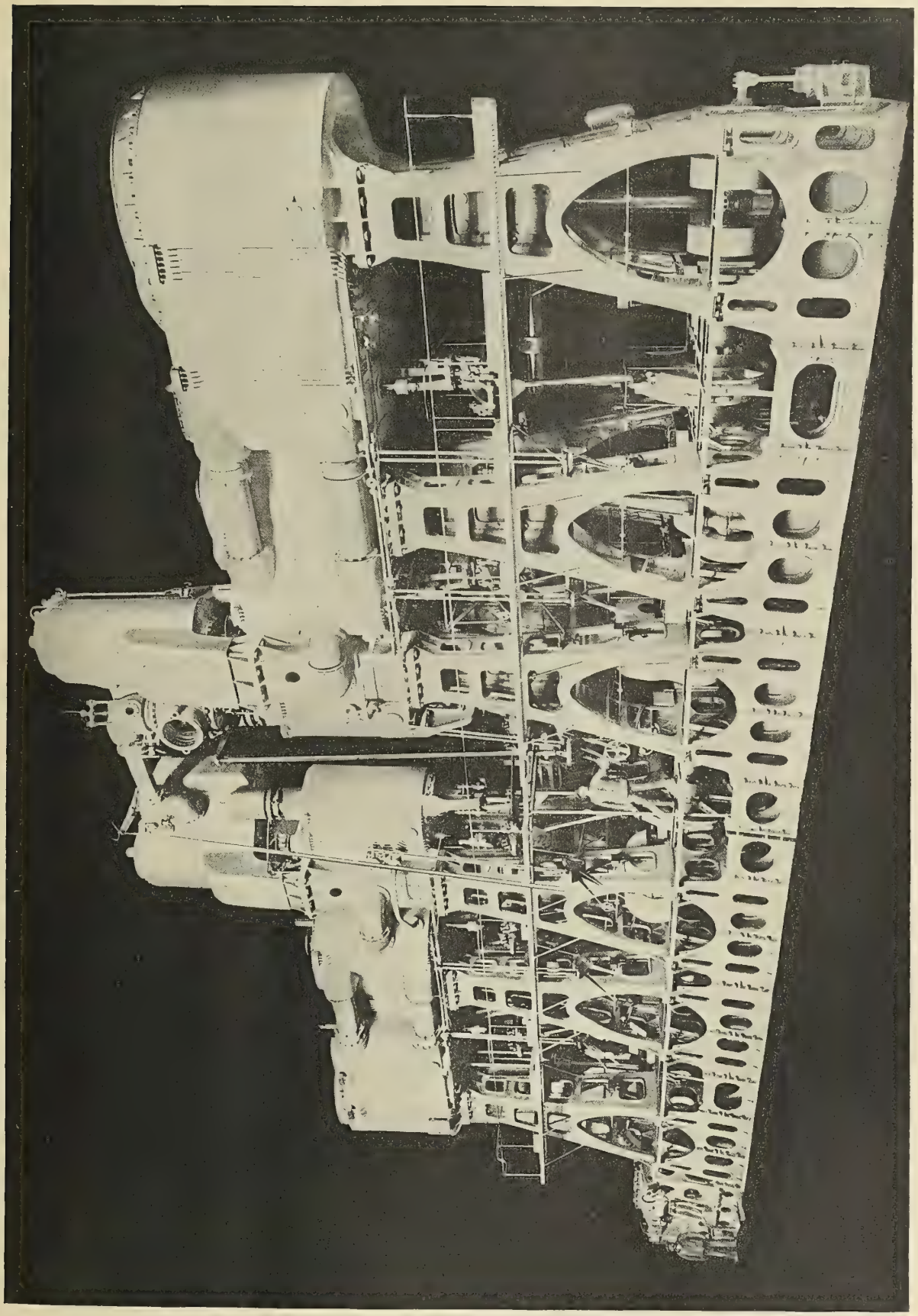
The question of electrical connections was quite thoroughly discussed in the third number of this series; therefore it will be unnecessary to consider it further here. In the figure are shown two batteries of four cells each, both positive poles being wired together and to the spark coil. The negative poles are connected to two terminals of a three-point switch, and wires are led from the switch and from the coil to igniter terminals on the engine. It is best to connect the negative electrode of a dry battery to the ground on the engine, rather than to the insulated point, since the case of the battery is generally composed of zinc and forms the negative side. With this manner of connection, should the battery in any way become grounded a short circuit would not occur. Both the battery and the coil should be placed in the dryest part of the boat and, if necessary, in a water-tight box, as excessive moisture destroys the efficiency of both the coil and of the battery.

(To be continued.)

Engines of the Kaiser Wilhelm II.

The power for driving the modern transatlantic liner is still on the increase, as is seen from the data of the engines for the new North German Lloyd express steamer *Kaiser Wilhelm II.*, which was recently launched by the Vulcan Shipyard, Germany. The machinery consists of four three-crank, quadruple-expansion, four-cylinder engines—two mounted on each shaft. The estimated indicated horse power of the four is from 38,000 to 40,000. For the double purpose of reducing the amount of power in one unit and cutting in two the possibility of a complete breakdown, there are two separate engines on each shaft, and each engine is placed in a water-tight compartment with its own auxiliaries.

The accompanying illustration, which is reproduced from the London *Engineering*, is taken from a photograph of two of the units. The high-pressure cylinder is mounted above the first intermediate cylinder; adjoining the latter is the second intermediate, and next comes the low-pressure cylinder. The diameters of these are, respectively, 37.4, 49.2, 74.8, and 112.2 inches, and the common stroke is 70.8 inches. The engines are balanced according to the Schlick system, and the two tandem engines are to be placed next to each other, with a bulkhead between. Ordinarily the two engines on one shaft will be operated from the forward engine room platform, but the levers are so arranged that the engines may be controlled from the after engine room, or each engine may be operated from its own compartment. As above stated, there is a complete set of auxiliaries for each engine, each engine room being self-contained, having one condenser of 11,732 square feet of cooling surface, one centrifugal pump, one Weir air pump, one single Weir heater and feed pump, and one double Weir boiler feed pump. There are also arranged in each engine room two independent duplex pumps.



DOUBLE QUADRUPLE-EXPANSION ENGINES FOR NORTH GERMAN LLOYD EXPRESS STEAMER KAISER WILHELM II.

The engines are designed to make 80 revolutions per minute, driving a four-bladed bronze propeller 22 feet 9.6 inches in diameter. The crank and thrust shafts are made of the best nickel steel, that of the forward engine being 20.87 inches in diameter, and of the after one, 25 inches in diameter. The propeller shaft is of crucible steel, 25.4 inches, and the line shafting is made of Siemens-Martin steel. The total number of engines on board, including the main engines, is seventy-nine, and there are one hundred and twenty-four steam cylinders.

Steam is to be supplied by twelve double-end and seven single-end Scotch boilers, with a total of 3,121 square feet of grate surface and 107,643 square feet of heating surface. Although natural draft is to be used, the boiler rooms are supplied with air from the deck above by eight fans when natural draft is not sufficient. The arrangement of the boiler rooms is such as to facilitate the transporting of coal to the boilers, and will be described in a later number. In the after boiler room are three double-end boilers, and in the next forward are three double-end and three single-end; in the third boiler room are three single-end and three double-end, and in the fourth boiler room are placed three double-end and one single-end boilers. In each boiler room will be a large feed pump and two ash ejectors, a steam ash hoist for use when in harbor, and other necessary apparatus. A ballast pump is also placed in the third boiler room.

LAUNCHES.

Tugboat Portland.—A handsome new tugboat, *Portland,* which has been built for the Central Wharf Towboat Company, was recently launched from the Portland Shipbuilding Company's yard at South Portland, Me. The tug is 93 feet 6 inches long, 20 feet beam, 10 feet 6 inches draft at full load. She will be driven by a compound engine with cylinders 14 and 30 inches in diameter by 20 inches stroke. This tug is designed for ocean-going as well as for coastwise work, and is sufficiently powerful to tow the largest steamers.

Steamship Arizonan.—The big freight steamer *Arizonan,* built by the Union Iron Works, San Francisco, Cal., for the American-Hawaiian Steamship Company, was successfully launched on September 20. The vessel is of 8,672 gross tons, measuring 486.5 feet over all, 57 feet breadth, and 32 feet depth. She is propelled by two quadruple-expansion engines with cylinders 21, 28, 38, and 60 inches by 36 inches stroke. Steam is supplied at 213 pounds working pressure by three single-end boilers 10 feet 4 inches long by 14 feet 3 inches diameter, provided with forced draft.

Steamer Muncie.—A fine package freight steamer was launched from the yards of the Detroit Shipbuilding Company, Wyandotte, Mich., on September 20. The vessel was christened the *Muncie* and is for the Anchor Line. The steamer is 372 feet in length over all, 350 feet length on keel, 46 feet beam, and 30 feet deep. Steam is supplied by three Scotch boilers, each 11 1-2 feet in diameter by 11 1-2 feet long, working at a pressure of 210 pounds. The engine is a quadruple with cylinders 19, 27, 40, and 58 inches diameter by 42 inches stroke. Her carrying capacity will be 5,000 gross tons, and it is stated she cost $290,000.

Steamship Texan.—The last of the three sister ships for the American-Hawaiian Steamship Company was successfully launched from the yard of the New York Shipbuilding Company, Camden, N. J., on August 16. The dimensions of the vessel are as follows: Length over all, 484 feet 3 inches; beam, molded, 57 feet; depth, molded, 42 feet 6 inches. Her displacement will be over 16,000 tons, and her carrying capacity is 11,000 tons.

Steam Yacht Coranto.—There was recently launched at Morris Heights the steel steam yacht *Coranto,* built from designs by Gardner and Cox for Mr. A. E. Austin, of Providence. The yacht is 155 feet long over all, 120 feet on water line, 20 feet beam, 12 feet 6 inches deep, and has a draft of 8 feet 6 inches. The owner's quarters, including four single and two double state rooms, with two bath rooms, all handsomely finished in white pine, mahogany trimmed, are located aft the engine room. The vessel is propelled by a triple-expansion engine with cylinders 11, 16, and 26 inches in diameter, with 15-inch stroke, and is supplied with steam by a Seabury water-tube boiler.

Mexican Gunboats.—Two gunboats, named the *Vera Cruz* and *Tampico,* were launched from the Crescent Shipbuilding Company, Elizabethport, N. J., on September 15, and are built to the order of the Mexican Government. The new ships are of the following dimensions: Length over all, 201 feet 6 inches; length between perpendiculars, 198 feet; breadth, molded, 32 feet 10 inches; depth, 15 feet 8 inches; draft, loaded, 10 feet; displacement, 980 tons. The vessels will be propelled at a maximum speed of 16 knots by two triple-expansion engines with cylinders 14, 22, and 36 inches in diameter by 24 inches stroke. In the boiler room, which is of the closed-stokehole type, are two 48-inch blowers with forced draft. The boilers are of the Mosher water-tube type, with grate surface of 81 square feet, designed for 250 pounds working pressure. The armament of each vessel consists of four 4-inch rapid-fire guns, one mounted on the forecastle, two in the waist, and one on the poop; four 6-pounders and one torpedo tube.

U. S. Cruiser Des Moines.—On September 20 the U. S. protected cruiser *Des Moines* was successfully launched at the Fore River yard, near Boston. The ship is one of the six sheathed and coppered cruisers purchased by act of Congress March 3, 1899. The contract was signed by the Fore River Ship and Engine Building Company, Quincy, Mass., on December 14, and the keel was laid August 28, 1900. The *Des Moines* has a load water line of 292 feet, an extreme length of 308 feet 2 inches, breadth of 44 feet, mean draft of 15 feet 9 inches, normal displacement of 3,200 tons, with a load displacement of 3,500 tons. The estimated speed with the engines indicating 4,700 horse power would be 16 1-2 knots; coal supply is, normal 467 tons, maximum 700 tons, giving a radius of 9,800 miles at 10 knots. The machinery consists of two 4-cylinder triple-expansion engines and six water-tube boilers. The diameters of the cylinders are 18, 29, 35 1-4 inches by 30 inches stroke. The grate surface is 300 square feet. The main battery will consist of ten 5-inch 50-caliber B.L.R., and the second battery comprises eight 6-pounders, two 1-pounder R.F.G., four Colt automatic guns, and one 3-inch field gun.

OPPORTUNITIES FOR ENTERING ENGINE-ROOM SERVICE.

So many inquiries have been of late received at the office of Marine Engineering from young men who desire to secure positions in the engine rooms on steamships that letters have been sent to the leading steamship companies of our coasts and Great Lakes, asking what are the requirements for entering this service. Also, we have made inquiry of the Revenue Cutter Service, and find that there are at present four vacancies in the list of second assistant engineers. A most interesting file of replies was received from the superintending engineers, and in general the tone was encouraging to young men who wish to become marine engineers. To classify the answers we have divided them under three headings: (1) Sea Service, (2) Service on the Great Lakes, and (3) Government Service.

Under the first class, in all but one of the companies written to, the superintendents are on the lookout for capable young men to start in the service. The requirements for entering the service differ somewhat, some superintendents stating that oilers are chosen from among the firemen and that the engineers are selected from oilers who hold engineers' certificates. In other lines it is the custom to select most of the oilers from a different class of men than those who serve as firemen.

In these positions, as elsewhere, it is evident that many of the men are anxious to get along too fast, for in one of the letters we find a hesitancy on the part of a superintendent to employ young men for this reason. In one instance the engineer must have five years' machine-shop experience before he becomes eligible, and in another case shipyard experience is the requisite. Generally speaking, in all the lines promotion is slow, and most of the superintendents prefer to encourage the good work of the firemen by promoting them to the position of oilers. On two of the lines the ships carry a limited number of cadets from fifteen to twenty-one years of age. These young men must have two years' experience in the machine shop, and it is found that those who are brought up in the country as farm hands are much better suited for the strenuous work in the fire and engine rooms than the city-bred boy. The general appearance and habits of the man count largely wherever a position of responsibility is to be filled.

The pay for beginners is about the same in all of the companies. In the two lines mentioned, where cadets are taken, the pay for the first month is $10. The pay of the coal passers is from $25 to $35; that of the firemen, from $35 to $40; oilers and water tenders, from $35 to $45; and assistant engineers, $80 and up.

In a word, there are excellent opportunities for the right class of young men, who are willing to begin at the bottom and work up. If they start in as firemen, they must be in first-class physical condition, for we know of no work which is more trying than that of firing on the modern Atlantic express steamer.

Following are extracts from some of the answers received:

No. 1. Southern Pacific Company, New York:

We do not accept young men without previous sea experience in the engine room. Application should be made by letter to the chief engineer. Applicants must have fair education, some mechanical training, and must be healthy. First-class machinists or boilermakers are preferable. The pay for oilers and water tenders is $45 a month. J. T. Vansickle, Agent.

No. 2. International Navigation Company, New York:

Application is made to the superintending engineer on a printed blank which may be had by writing to the company. The rule in this company is that all engineers shall work up from the lower positions, and that any engineer joining the company must be at least a first-class machinist, which means that he must have served a regular apprenticeship of not less than three years at the building or repairing of engines. Any boy starting out with a good public school education is sufficiently well equipped to enable him to acquire all the engineering education he will need to obtain the necessary licenses required by the Government in order to get positions higher than juniors. It is, however, as you know, to the benefit of the boy to have a good engineering education before going to sea. James Carnegie, Supt. Engineer.

American Line. Red Star Line.

APPLICATION FOR EMPLOYMENT.

OFFICE OF

SUPERINTENDING ENGINEER,

Pier 14, N. R., New York.

Jas. Carnegie, *Superintending Engineer.*

Name .....
Age .....
Address .....
Married or single .....
By whom introduced .....
Position sought .....
What certificate held, date and No. .....
In whose employ apprenticeship was served .....
In whose service since expiration of same .....
What positions held? .....
What sea service have you had? .....
Last employers .....
Cause of leaving last situation .....
Has your certificate ever been suspended? .....
Names and addresses of referees .....
Are you a citizen of the United States? .....

.....

(SIGNATURE OF APPLICANT.)

No. 3. New York and Texas Steamship Company, New York:

We are on the lookout at all times for young men who wish to begin at the bottom in the engine room and grow up with the business, but find the great difficulty to be that while they may think that they want to grow up with the business, they want to grow up a great deal faster than the business will warrant, and our object is to have men in our employ who are looking forward all the time to higher positions and will prove they are capable of advancement as fast as the opportunity offers. Applications are made to our marine engineer. The applicants should have a good education, should be in first-class physical condition, and we would like to have them as far advanced as possible. The wages are such as are applied on all

steamers going out of New York. There is very little difference in any of the lines. We find the great difficulty in procuring this kind of men is that the majority of them are not willing to wait until they are thoroughly competent to handle the higher-class jobs, but wish to be advanced very rapidly, and we consider that a man capable to take charge in a large ocean-going vessel should be thoroughly conversant with all the details both in the fire room and engine room.

C. H. MALLORY AND COMPANY.

No. 4. Maine Steamship Company, New York:

Our engine and fire-room force is composed of men only; we have no class of apprentices. The oilers and engineers are secured from the steadiest men in the fire room. We are very glad to get men of such caliber that they can be advanced. Application should be made to the chief engineer. A green man, of course, would be put in the fire room and would require physical qualifications to enable him to stand the work. The pay of a coal passer is $35 per month; firemen, $40; oilers, $45; and assistant engineers, from $80 up.

No. 5. Boston and Philadelphia Steamship Company, Philadelphia:

It is always our desire to advance men in the engine room, providing they merit it. We have no regular form of application. Simply call in and see the superintending engineer, or address a letter to him. We require an applicant to know how to read and write and to be in good health. Our pay ranges from $25 to $40 per month for beginners. The title of the three positions that we take on beginners to fill are: coal passer, fireman, and oiler. I have filled all the above positions myself, and my advice to young men taking up the engineering branch of a seafaring life is to stick at it, for there are times when one will become discouraged with the unavoidable happenings that go with it. H. B. VANSCIVER, Supt. Engineer.

No. 6. Old Dominion Steamship Company, New York:

Positions for oilers are, whenever possible, filled by selecting mechanics that have served an apprenticeship in a marine machine shop. Occasionally, however, deserving firemen are promoted to this position. Oilers, when holding a certificate and are competent, are promoted to engineers. An oiler's pay is from $35 to $45 per month. Applications are made to this office.

H. C. HIGGINS, Supt. Engineer.

No. 7. Quebec Steamship Company, New York:

In the first place, it is necessary for an applicant to have a fair preliminary education; secondly, he must have served a full and regular apprenticeship of five years to the engineering trade in some shop or works where marine repairs or engine building are carried on. Of course, physical conditions and personal appearance are to be considered in selecting engineers for our ships. An engineer applying to this company for an appointment, must make out his application in writing, stating his experience, when and where he has been employed, and confirm same by submitting copies of his testimonials to us. HORACE BLACK, Supt. Engineer.

No. 8. Eastern Steamship Company, Boston:

The chief of each steamer hires his own employees, who are taken from points along our routes. Firemen are paid $35 and oilers $40 a month, increasing as they are promoted. CALVIN AUSTIN, V.-P. and Gen. Mgr.

No. 9. Merchants' and Miners' Transportation Company:

Applications are made to the superintendent by letter and in person if possible. Firemen and coal passers are employed directly by the engineers aboard ship, unless it is desired to start some man, and often they are placed aboard by this office. Wages of firemen, $40 per month, and coal passers, $30. Oilers are appointed from this office, and a man's general fitness for the position is considered. His previous experience is looked into and men of experience are given preference. The policy of the company is to promote the oilers to assistant engineers as soon as they become qualified.

J. M. BLANKENSHIP, Supt.

No. 10. Pacific Mail Steamship Company, San Francisco:

As a rule the firemen and coal passers are a class of men who by education, surroundings, and station in life are seldom qualified for positions as marine engineers. It is of paramount importance that any one desiring to be a licensed marine engineer must have a thorough knowledge of machinery in all its details, as well as the use and handling of tools in connection with that department. The only place that this can be learned is in the machine shops or engine and shipbuilding plants of the country, and I think I am safe in saying that every United States licensed engineer in our employ has served such an apprenticeship toward qualifying him for his position. There is no place on board the ship where this training can be had. My advice to any young man desiring to become a marine engineer is to first serve a full apprenticeship in some shipbuilding plant. ALEX. CENTER, Gen. Agent.

No. 11. The Pacific Coast Steamship Company, Seattle, Wash.:

Answering your inquiries concerning the opportunity for young men to get employment in the P. C. S. S. Company, would state as follows: The inducements that this company has practiced for the past twenty-five years are steady employment, promotion, and good pay to all employees that serve the company faithfully and well. Every man that accepts a position from the P. C. S. S. Company has it in his power to advance to the highest position in whatever department he may elect to serve in. Applications are usually made to the heads of the departments; engineering department, to the superintendent engineer; deck department, to the port captain. The form used is as per copy enclosed herewith. A good education is one of the essential features for beginners in the engine and deck departments. I would say that the young man with shop training would be better equipped for advancement than the one that did not possess it. Promotions are sometimes slow, and it requires patience to wait until the opportunity comes. Impatience and restlessness have wrecked many ambitious young men striving for promotion.

Physically, I would recommend the strong and healthy for positions on shipboard. Weak stomachs are out of place when rough weather prevails, as the "Professor on Shipboard" will bear me out in this. We have no wage schedule for beginners. Coal passers receive $40 per month; firemen, $50; oilers, $40; water tenders, $55. The young man seeking the information which your letter contains should acquaint himself with the rules and regulations of the U. S. Inspection requirements for

application of engineer's license, also requirements for mates, pilots, and captains.

C. C. Lacey, Consulting Engineer.

Application No.....

PACIFIC COAST STEAMSHIP COMPANY.

APPLICATION FOR EMPLOYMENT.

Date.....190..

1. Full name of applicant .....
(Write given name in full.)
2. Employment desired .....
3. Age ..... 4. Place of birth.....
5. Have you ever been employed before by this Company?.....
6. If so, in what capacity employed?.....
7. If so, where employed?.....
8. If so, give date of entering service.....
9. If so, give date of leaving service.....
10. Reasons for leaving.....
.....
.....
11. Have you any physical ailment or defect which might render you unfit for service you seek?.....
12. Have you ever suffered any physical injury?.....
If so, state particulars.....
.....
.....
.....

Usual signature of applicant.....
Present address .....

I consider the above described applicant a suitable person to enter the Company's regular service. I desire to employ him as .....at or on.....
Effective .....190.. Rate of pay $.....
Approved ....Name and .....Title.

Applicants under 21 years of age must furnish minor's release with application.

(On reverse side is space for stating positions previously held.)

No. 12. Quail's Shipping Office, New York:

Regarding cadets for steamships, it is necessary in the first place that a boy should have at least two years' sea experience for deck cadet and two years' experience in a marine shop for engine-room cadet. He must not smoke cigarettes nor drink rum, and must be between the ages of fifteen and twenty-one years. We find the very best boys are those who have been brought up on a farm, for city boys make very poor steamship cadets.

John H. Quail.

No. 13. Marine Engineers' Beneficial Association, Philadelphia:

Replying to your inquiry, I beg to say that the wages for chief engineers on the coast are from $115 to $150 per month, according to the class of steamer and nature of service; first assistant, $75 to $90; second assistant, $70 to $80; third assistant, $55 to $70; oilers, $45; water tenders, $45; firemen, $40; coal passers, $30; with about the same condition prevailing on the Great Lakes, with the exception that on the Lakes the season is about three months shorter. I am of the opinion that the chances for advancement of young, capable, energetic men are good, and that good positions may result from persistency and faithful application, which are conditions that never fail of recognition.

George Uhler, President.

SERVICE ON THE GREAT LAKES.

Service in the engine room of the steamers on the Great Lakes is somewhat different from that on the coasts, as here unionism is very strong. It is practically impossible for a man to get employment as fireman, coal passer, oiler, or engineer unless he belongs to the union. The wages, which are settled between the Lake Carriers' Association and the Longshoremen's Union, are higher than on the salt water, but the season is shorter, opening about the middle of April and closing generally about the middle of December. The engineers are taken on board, however, about the middle of March for fitting out the vessels.

From the answers received from several of the transportation companies of the Lakes, we make the following extracts:

No. 14. Cleveland and Buffalo Transit Company, Cleveland:

All the employees of our engineering department belong to the union, which, of course, necessitates our looking to the head of this organization in the different cities where we land. Wages are governed by the Lake Carriers' Association. F. F. Newman, Gen. Manager.

No. 15. Erie and Western Transportation Company, Buffalo:

We are always glad to get hold of capable and energetic young men, of course preferring men who have had some shop experience. They would have to start in as oilers, which position at present pays $52.50 per month. After serving an apprenticeship they are, as you know, examined by the U. S. Inspectors for second engineer. We try to pick out men having fairly good education, as well as men being in good physical condition. "Unionism" seems quite the thing on the Lakes at present, and it would undoubtedly be necessary for a young man seeking work of this nature to belong to the union. Application for a position of this sort should be made to the chief engineer of the line. The engineer's crew are put on board about the middle of March and the vessels are brought out a month later.

E. T. Evans, Western Manager.

No. 16. Goodrich Transportation Company, Chicago:

The policy of this company is to advance its employees, whenever possible, when the employee is worthy. There is no regular form of application, but the applicant should apply either to the superintendent or chief engineer of the line. Education and physical condition are taken into consideration, but previous training is more essential. This year we have paid coal passers $18 per month; firemen, $45; and oilers, $47.50. The labor conditions are such that we have had to accept any and all kinds of help, not being able to pick same. The men that are engaged in the occupation of firemen are not of a class that a young man of good habits would care to associate with, and for this reason it is hard to get men to take up the firing position. With the oilers it is somewhat different. Their living quarters are better than those of the firemen. At this season of the year we are cutting down rather than adding to our force. The time to apply to us would be along in the early spring.

H. W. Thorp, Gen'l Manager.

No. 17. Pittsburg Steamship Company, Cleveland, Ohio:

Men are hired by the chief engineers of the ships, unless in some cases the engineers write or telegraph the home office to send them a man. When they do this we endeavor to secure men who have had experience in the business. While education is a grand thing for young men entering the engineering department on ships, as well as in other business, at the same time it

is of very little use to them in their daily work. Even a first-class mechanic has no chance to practice his trade when acting as a fireman or oiler on lake steamers. They have their regular line of work to perform and are not asked to do anything else; in fact, are not permitted to do any of the fine work, such as adjusting or fitting parts, or anything of that kind. The proper way for a young man to get a position is to apply direct to the chief engineer of a ship. If he is industrious and intelligent his chances are excellent for rapid promotion. F. B. Smith, Asst. Chief Engineer.

No. 18. Lake Carriers' Association, Cleveland, O.:

Young men as a whole gravitate into the engine room as oilers, water tenders, or firemen, with machine-shop experience. The wages are at present $52.50 per month, though up to the 1st of September they had been $47.50. The usual method is to apply to a fleet manager, who would, if favorably disposed, refer the applicant to his chief engineer, and the chief engineer would in turn send him to the engineer on board the ship.

Geo. P. McKay, Treasurer.

MARINE ENGINEERS IN GOVERNMENT EMPLOY.

Among the thousands of Uncle Sam's employees, it is safe to say that every trade and profession known to civilized life are represented. As numerous vessels of all descriptions are necessary for all well-regulated governments having sea coasts, and navigable rivers, and other bodies of water, the profession of marine engineering is quite naturally called upon to furnish its quota of Government employees. To the uninitiated in such matters, a person holding any kind of Government position is looked upon as one enjoying more or less of a sinecure. He is also thought to be the possessor of considerable "pull," as political influence is rather tersely expressed. While these conditions existed to a certain extent not many years since, quite the opposite state of affairs is now extant. Especially is this so with those employed as marine engineers, where for obvious reasons political influence has but little weight in the selection of men to fill such important positions.

Of the several maritime services which form part of the Government, the navy naturally is the most important. With great battleships such as we now possess, having steam machinery costing in single cases over a million of dollars, the personnel must be carefully selected and well trained for the trying duties imposed upon it. The commissioned officers who perform engineering duty at sea are, of course, all graduates of Annapolis. As this sketch is to treat only of positions available to persons in civil life, no more need be said of the commissioned force, except that it is admittedly inadequate in numbers, and that undoubtedly before many more years there will have to be large reinforcements taken in from civil life. That phase of the situation will naturally interest those contemplating a life in the navy and who are unable to obtain a cadetship at the Naval Academy.

To enter the naval service in the engineering branch it is now necessary to begin at the bottom of the ladder and work up. As there is comparatively little chance for a man to gain advancement from coal passer through the grades of fireman and oiler, and become a machinist, as those who operate the machinery are termed, it is much better to learn the trade on shore and then to enlist as a "machinist." The following rules for such enlistment are published by the Navy Department:

1. A candidate for enlistment as a machinist must be a machinist by trade, must know the names and uses of the various parts of marine engines and boilers, and must be able to perform work with various tools in a machine shop, including bench work.

2. He must be able to write legibly, and must understand arithmetic.

3. He must be physically sound, and at the date of first enlistment must be not less than 24 nor more than 35 years of age.

4. Machinists who have had no experience at sea with marine engines will be enlisted as "machinists, second class," at $40 per month.

5. Machinists who have had experience at sea with marine engines for one year may be enlisted as "machinists, first class," at $55 per month.

6. No person will be enlisted as chief machinist unless he holds a permanent appointment as such.

7. The examination of candidates for enlistment as machinists, regarding their knowledge of engines and boilers, must be made in the engine rooms of ships; and regarding their knowledge of machine work, in the workshops of navy yards.

There are at all times vacancies for first-class men who possess the foregoing qualifications. Application for enlistment can be made at any navy yard or at any recruiting station. After entering the service as a second-class machinist, for instance, any man who is sober and attentive to his duties will find rapid advancement. There is a corps of warrant machinists, 150 in number, who are appointed from the enlisted machinists upon the basis of their records, and also as the result of competitive examinations. These positions are for life and are practically the equal, with the exception of pay, of commissions, as they are entitled to the benefits of retirement and of the pension list. The first three years after date of appointment they receive $1,200 per annum at sea and $900 on shore; the second three years, $1,300 at sea and $1,000 on shore; the third three years, $1,400 at sea and $1,300 on shore; the fourth three years, $1,600 at sea and $1,300 on shore; after twelve years from date of appointment, $1,800 at sea and $1,600 on shore.

With such salaries as these and the possibility that commissions and increased compensation may eventually be given to warrant machinists, the naval service presents an attractive field for ambitious young marine engineers.

Under the Treasury Department there are several branches which employ marine engineers, the most important of which is the Revenue Cutter Service.

There are at present four vacancies in the list of second assistant engineers of the U. S. Revenue Cutter Service. These offer exceptionally fine opportunities for bright young marine engineers to obtain a life position. The examinations for this service are strictly competitive and are open to any American citizen between the ages of 21 and 28 years who has had not less than six months' sea service and has served not less than eighteen months in a machine shop. No political influence is necessary, as permits to take the examina-

tion will be issued to any applicant who produces satisfactory certificates as to age, moral character, and sea or shop experience. Candidates must be sound physically, as a rigid examination is given each competitor by a board of Marine Hospital surgeons before the professional examination is begun.

The professional examination is wholly written and will be conducted by a board of engineer officers of the service. It will consist of questions on the English language, arithmetic, algebra, trigonometry, physics, elementary mechanics, heat, steam and expansion, the chemistry of combustion and corrosion, boiler design, practical questions on the care and management of marine engines and boilers, valve gears, proportions of screw propellers, electricity on shipboard, the use of the indicator, and interpretation of diagrams, etc. It is not at all necessary that candidates have a college education, as there have recently been several appointments made of bright young men who have obtained their education by their own efforts in studying standard text-books on the subjects named.

Since the recent enactment of a law giving U. S. Revenue Cutter officers the same pay as officers of equal rank in the army, these positions are very desirable from a financial standpoint. Immediately upon appointment a second assistant engineer receives $1,400 per annum. He is then in the line of promotion, and as a first assistant engineer will receive $1,500 per annum, and as a chief engineer his salary will be $1,800 a year. In addition to these basic salaries officers receive 10 per centum additional for each five years of service up to a total of twenty years' service, when this increase stops. A chief engineer who has been in the service for a period of twenty years would therefore receive $2,520. A first assistant engineer who has been in the service for, say, ten years would receive $1,800 a year. Under the old system prior to the passage of the new law the salaries were $1,200, $1,500, and $1,800, respectively, with no increase for length of service.

Further particulars as to the time and place of examination, method of application, etc., can be obtained by addressing a letter to the Hon. Secretary of the Treasury, Washington, D. C.

The Marine Hospital Service and the Coast Survey give employment each to a small number of marine engineers. Appointments are made through the civil service, and the qualifications necessary are such as are required for licenses from the Steamboat Inspection Service. The salaries paid vary from $50 to $125 per month, according to the grade of license and size of vessel.

Marine engineers are also employed on vessels of the Lighthouse Service. They are appointed through the civil service, except that the examinations are made by the Inspector in charge of each district. The examinations in this service are also the equivalent of those given by the Steamboat Inspection Service. The average pay for chief engineer is $90 to $100 per month, although on some of the larger vessels they receive $125 per month. Assistant engineers average $80 or $90 per month. Since the steam lightships have come into use, opportunities are offered on them for engineers. For licensed men who like to lead a quiet life and not do much cruising, these vessels offer exceptional opportunities. The chief engineer of a lightship receives $960 per year, and his assistant has $780 per year to spend (if he ever gets ashore). These vessels are a novelty in one feature at least; that is, that the chief engineer gets $60 a year more salary than the captain receives, which is a step in the right direction.

During the war in the Philippines a large number of licensed marine engineers found good positions on the vessels of the Army Transport Service. The number of vessels in this service is now greatly reduced, and the chances for employment likewise diminished. The wages paid are about the same as those in the merchant service, varying from third assistant at $65 per month up to chief engineer, some of whom receive as high as $200 per month.

An opportunity for employment on shore, to those marine engineers who are tired of going to sea, is offered, in a somewhat limited field, by positions in the corps of Assistant Boiler Inspectors in the Steamboat Inspection Service. These positions are quite lucrative and can be obtained by competitive examination before civil service examining boards. Some of the more important requirements are that the applicant must be a resident of the local inspection district in which the vacancy occurs; that he is physically able to crawl through a 9-inch by 15-inch manhole; that he has had three years' actual practical experience as chief engineer of ocean or inland steamers of over 100 gross tons, as first assistant engineer of inland steamers of 600 gross tons or over, or as first assistant engineer of ocean steamers of 1,500 gross tons or over; that he is between 25 and 55 years of age.

Those possessing the above qualifications are given a competitive examination in the following subjects:

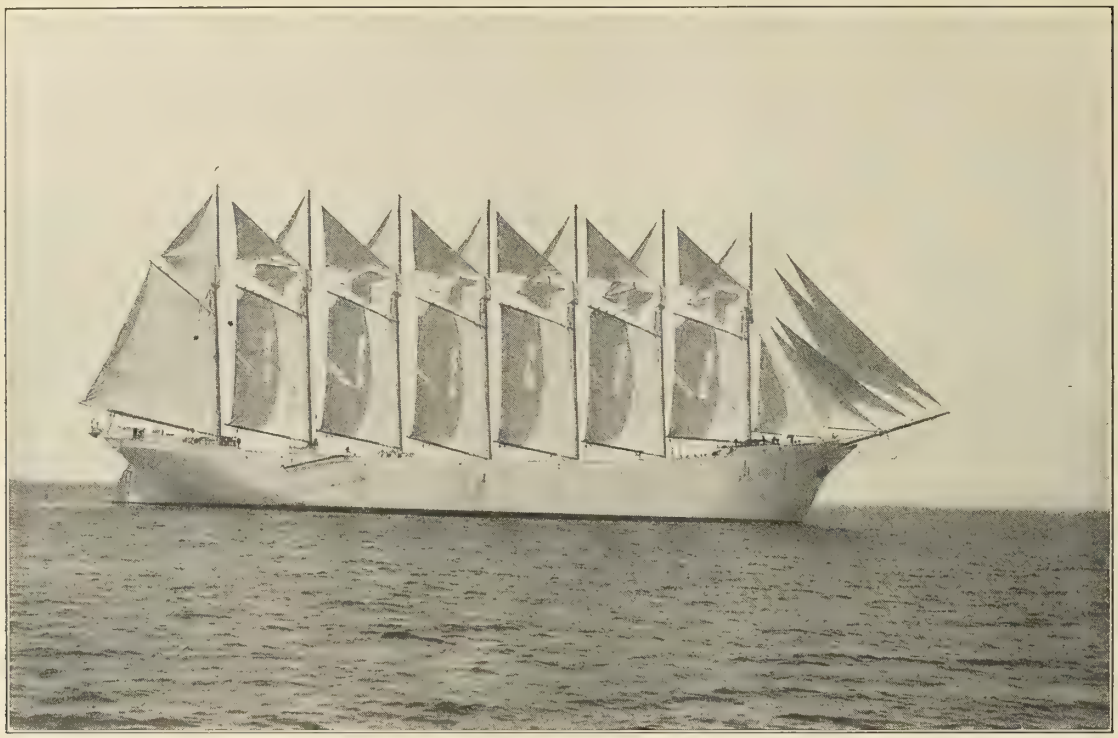
1. Letter writing.
2. Arithmetic (consisting of problems in common and decimal fractions, mensuration, and square root).
3. Boilers and machinery (comprising practical questions relating to boilers, engines, and machinery of steam vessels, and strength of boiler materials).
4. Experience (based on applicant's certificates, etc.).

The salaries at the beginning vary from $1,200 to $2,500 per year, and the positions are practically for life, depending, of course, upon good conduct.

Engineers who have been to sea are often in demand in what is known as the "Custodian Service," connected with the care of public buildings. The age limits are between 21 and 55 years, and the salaries paid vary between $720 and $1,080 per annum. The questions given applicants are such that any licensed marine engineer should be capable of answering, and apply to steam-heating and electric plants as well as to steam plants.

From the foregoing it will be seen that there are many opportunities for ambitious young marine engineers to gain permanent positions in the Government service. With but few exceptions, all the positions herein named are within the reach of those who have the ability to fill them.

Floating Machine Shop.—A naval constructor of the Boston Navy Yard has recommended that a floating machine shop be built for use in repairing ships. The shop is to be built on a scow which is to be thoroughly equipped with machines and tools for carrying on repairs.



THE THOMAS W. LAWSON UNDER FULL SAIL.

(Copyright, 1902, G. W. Davenport.)

MECHANICAL EQUIPMENT OF A SEVEN-MASTED SCHOONER.

The seven-masted schooner *Thomas W. Lawson* was put into commission and towed from the Fore River yard to her anchorage off South Boston on September 8, her glistening white hull looking as little as possible like that of a collier. She made her first trip to Philadelphia for coal under the command of Captain Arthur L. Crowley. The official measurements made after the schooner was afloat are as follows: Gross tonnage, 5,218; net, 4,914; length on water line, 368 feet; beam, 50 feet; and depth, 35 feet 3 inches.

The schooner has steel lower masts 135 feet long and pine topmasts 58 feet long, and the height of her topmast head is 155 feet from the deck. Her steel bowsprit is 85 feet long. The lower masts, which are 32 inches in diameter and which weigh, complete, nearly 20 tons each, were stepped before the schooner was launched. The masts were moved alongside on rollers, the yard locomotive hauling them to the slope of the beach. A very large pair of shears were erected on the deck, with falls connected with one of the schooner's own winches, and when the masts were hoisted they were kept away from the ship's side by means of steel guys. The aftermost mast, called by Captain Crowley a "pusher," was stepped first, and the shears, which stood at right angles to the fore-and-aft line of the schooner, were warped forward for each successive mast.

The machinery was also installed while the schooner was on the stocks. Steam power is furnished by two vertical boilers, 56 inches in diameter by 90 inches high, one in the forward house and one in the after house,

MANOEUVERING IN BOSTON HARBOR.

(Copyright, 1902, G. W. Davenport.

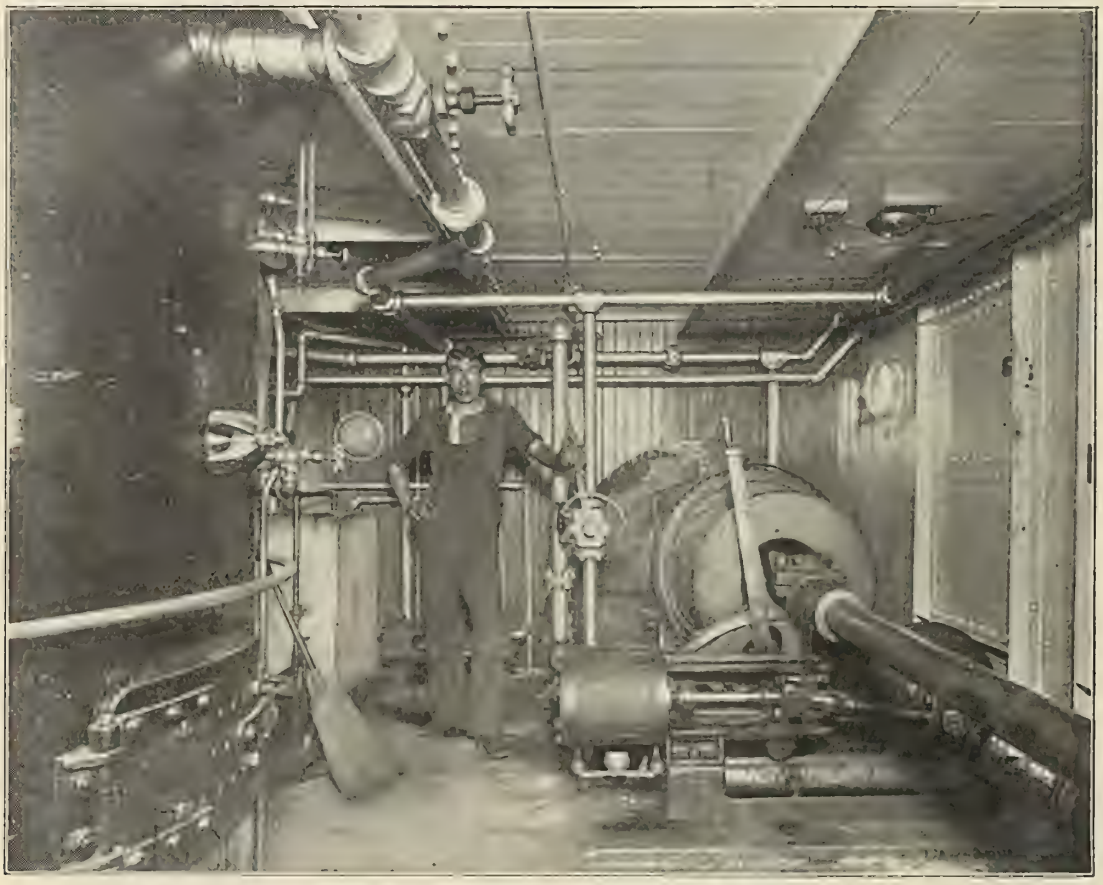
with inspirators, injectors, and all the concomitant fittings. There is one 9 by 10-inch double-cylinder ship engine for the forward house, with friction drum and winch heads on an extended drum shaft on the outer end. There are also five 8 by 8-inch hoisting engines, with link motion, on deck, with galvanized iron winch heads on each end of the drum shaft. Two coil condensers are employed to condense the exhaust steam for the hoisting engines, and each will feed a fresh-water tank of 300 gallons capacity. There are two direct-acting steam pumps for drainage purposes with steam and water cylinders, each 12 inches in diameter by 12 inches stroke. There is also a 6 by 4 by 6-inch duplex donkey pump of the packed-piston type, located near the after boiler, and one 7 1-2 by 5 by 7-inch pump of similar type located near the forward boiler, both piped for use as circulating pumps and also for washing decks and for fire purposes. Two hand pumps of the deep-chamber type are provided for emergencies. The windlass is of the Hyde pump-brake type with double-geared messenger attachment and iron bitts. Wildcats are fitted for a 2 3-4-inch chain. The windlass which is used for hoisting the 10,000-pound stockless anchors is under the forecastle deck, and the 40-horse-power engine which is connected with it by a messenger chain also operates a "nigger head" on deck. On the fore-

DECK VIEW ON THE SEVEN-MASTED SCHOONER THOMAS W. LAWSON, LOOKING FORWARD.

castle deck there is also an independent steam capstan to be used for warping or other purposes.

The machinery is so arranged that it can be operated by two engineers to do all the work required. The after engine, for example, which has 25 H.P., is enclosed in a deck house with the after boiler and steam pump, so that all can be under the command of one man.

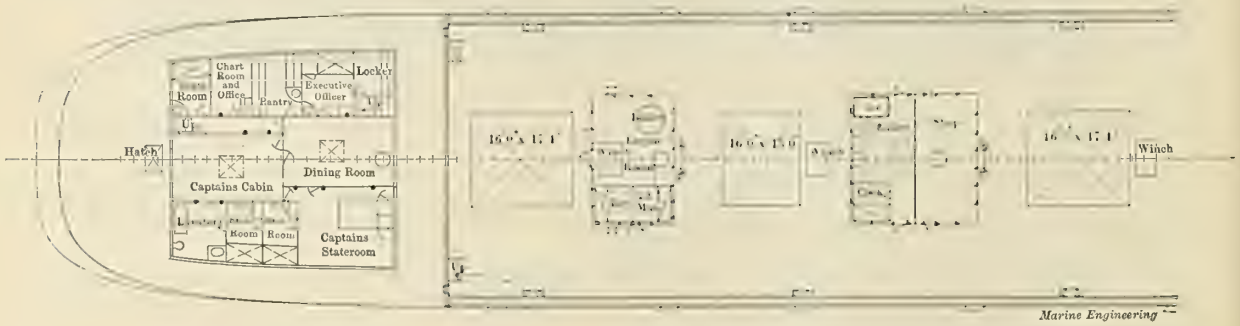
are trained through lead blocks in a line with the shrouds and then led through snatch blocks to the winch heads. The foremast has five 4 3-4-inch steel-wire shrouds, while there are four for each of the other masts. In addition to a double forestay there are two knighthead stays and two jibstays, each of 4 3-4-inch wire, with a total breaking strain of about 200 tons.



FORWARD ENGINE ROOM ON THE THOMAS W. LAWSON.

It is designed in hoisting and trimming sail that all the work should be done by the forward and after engines. The halyards from the three forward masts and for the forestaysail and jibs train to the forward winch, while the halyards from the four after masts train to the after winch. The peak and throat halyards, jib halyards, topsail halyards, topping lifts, and sheets

The *Lawson's* suit of sails comprises seven spencers, seven topsails, seven topmast staysails, a fore staysail, a jib, a flying jib, and a jib topsail. She has besides five storm trysails. The spencers, which weigh about three-quarters of a ton each, are hoisted by throat halyards with a fourfold block at the masthead and a triple-throat halyard becket. Each peak halyard has



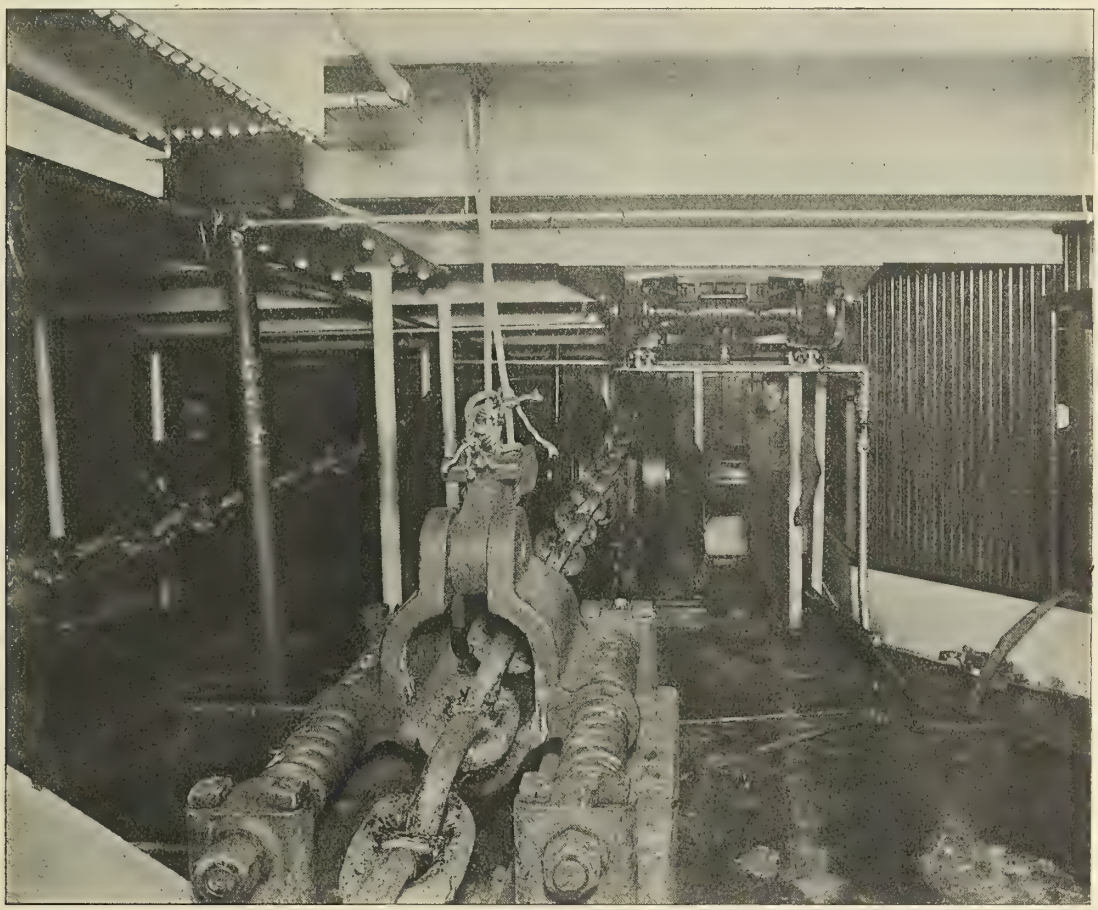
DECK PLAN OF THE SEVEN-MASTED SCHOONER THOMAS W. LAWSON,

one double and two single blocks at the masthead and four single blocks on the gaff. Two sails can be hoisted at the same time, the throat halyards being led to the port and the peak halyards to the starboard winch heads.

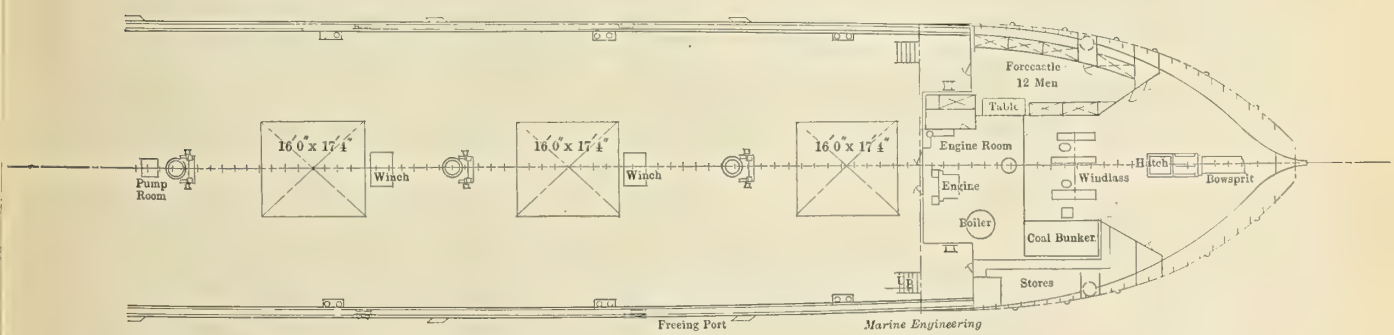
The four amidship hoisting engines of 25 horse power each will be used for hoisting or trimming the light sail after the schooner is under way and there is plenty of time for the engineers and men to go from mast to mast and handle one sail at a time. But the chief uses of the amidships engines will be for loading or unloading cargo. Each of the six engines is forward of a hatch, and forward of each engine is a mast to which a spar can be rigged for hoisting purposes. It is therefore possible, if enough men are employed, to handle cargo from all six of the hatches at the same time. The smokestacks from each of the boilers branch off laterally to port and starboard, so that by closing the windward opening the smoke will go to the leeward of the masts and sails.

The *Lawson* has four steam pumps, two of which, working together, will pump 6 tons of water a minute and can unload 1,000 tons of water ballast in about two and a half hours.

The steam-steering gear is of the Hyde pattern and is operated by means of a worm acting on a shaft which has a right-and-left screw thread, with one nut attached to the starboard end of the rudder crosshead and the other to the port end.



ANCHOR HOIST AND DEVIL'S CLAW IN FORECASTLE.



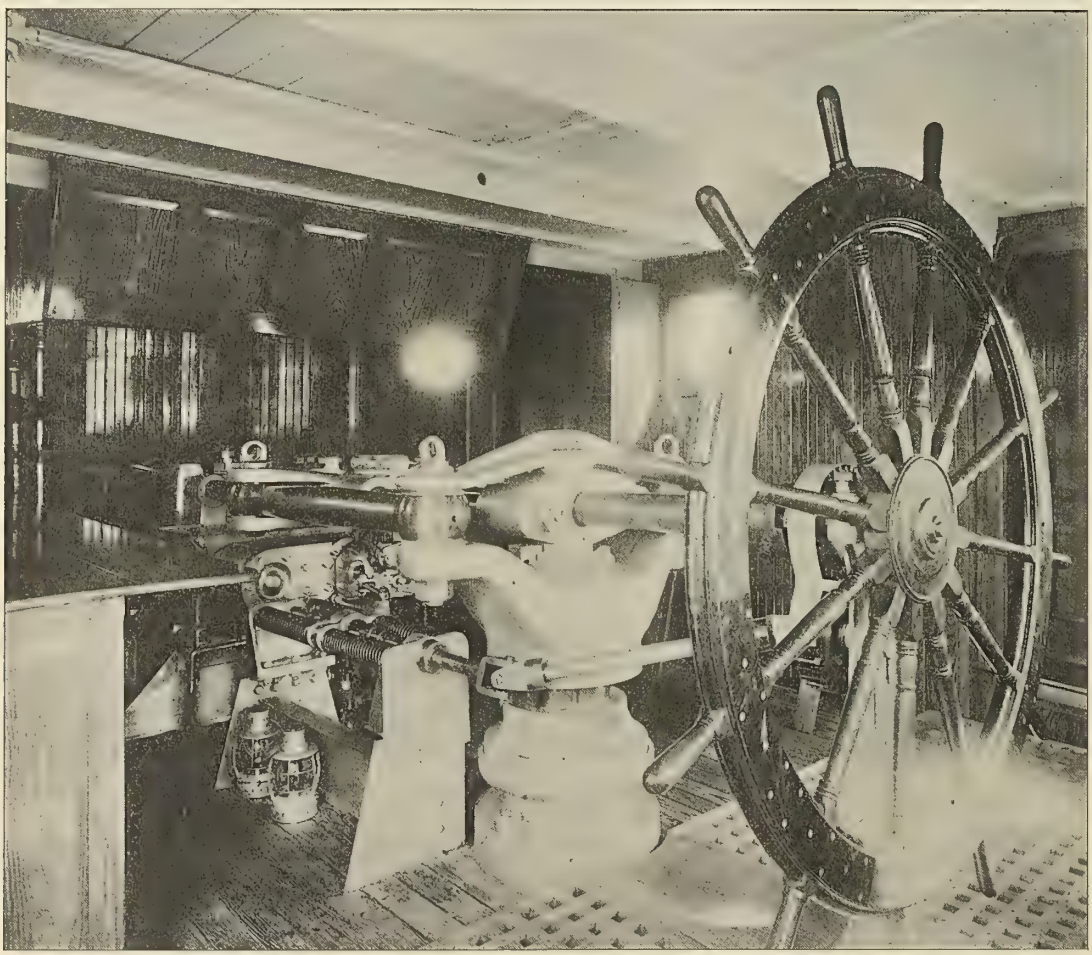
BUILT BY THE FORE RIVER SHIP AND ENGINE COMPANY.

The mechanical equipment of the schooner includes a telephone circuit connecting the wheel house with both the forward and after engine rooms, and an electric-lighting plant of sufficient capacity to light the whole ship with incandescent lights.

It is believed that the *Lawson* is the first of a type of vessels which will revolutionize ocean freight carrying. The five-masted schooner *John B. Prescott* and the six-master *George W. Wells* had already demonstrated the economy of large sailing vessels, and on the latter schooner steam had already been employed for handling sails and the number of men in the crew materially reduced. The *Lawson*, with her engines, will require the services of but 16 men all told, whereas a square rigger of the same size would need at least 35 men; and it is expected that the schooner's sails can be changed in about a third of the time that would be necessary for the same operation on a square rigger. The economy over steam-propelling power is thus very evident.

The limit of size for a wooden vessel seemed to Captain J. G. Crowley, the managing owner, to have been reached in the six-master, and consequently he awarded the contract for the seven-master to a steel shipyard, instead of to one of the wooden yards on the coast of Maine from which most of the big schooners have been launched. Not only would an excessive strain be put upon a vessel's hull by so many masts and such heavy rigging—the *Lawson* spreads 43,000 square feet of canvas—but the keelson which a wooden ship of anything like the same dimensions would require occupies so much space that might otherwise be given to cargo, and is in itself such a burden to carry, that a double economy would be accomplished by steel construction. The carrying room gained by the difference in the thickness of the hull is also an appreciable item.

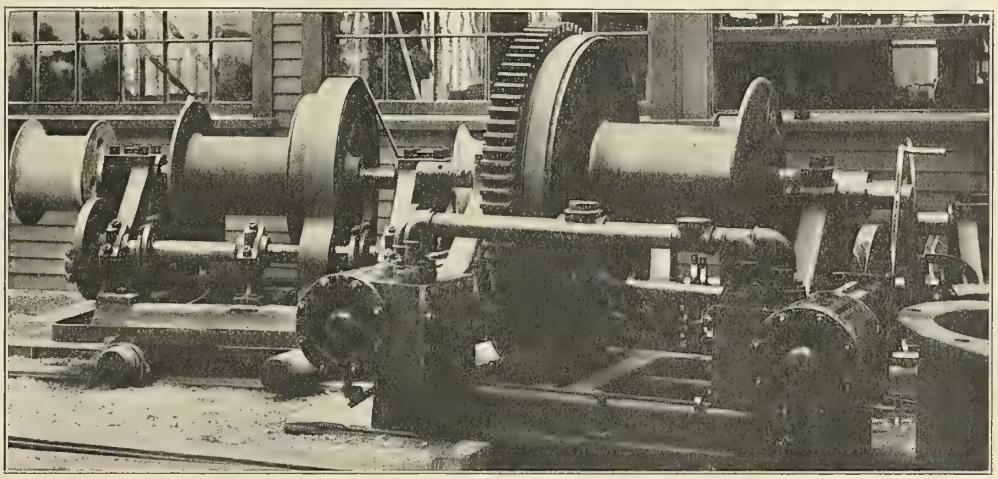
The *Wells* is 335 feet long over all, with 48 feet beam; the over-all length of the *Lawson* is 403 feet 4 inches (the other dimensions are already stated), and when fully loaded she will draw 26 feet 6 inches. With this size she has a carrying capacity of 8,100 tons—nearly twice the capacity of the six-master, and three or four times that of many steam freighters. While these increased proportions give such greatly increased carrying capacity, the fixed charges—wharfage, pilotage, towage, and all manner of port expenses—are but little increased. Being a schooner, too, the *Lawson* has an advantage over any other type of sailing vessel in the cost of towage, for example; and her equipment of engines will enable her to do much of her own stevedore work, which will be no little economy, especially when she is in foreign waters.



STEERING GEAR AND WHEEL HOUSE OF THOMAS W. LAWSON.

In various other respects the use of steel and steam

will give the *Lawson* marked advantages. She has been built of steel in a very much shorter time, for instance, than she could possibly have been built of wood, her launching being set for just about eight months after the laying of the keel. Fully fitted out and classified as A 1 for 20 years, she will have cost $250,000, which is not much more than wooden construction would have cost, and what little difference there is in the initial expense will be soon made up, Captain Crowley feels assured, by the saving on repairs. She is to have a double bottom four feet deep, in which, if need be, a thousand tons of water ballast may be carried. The pump well gives free access to the double bottom, so that at any time a man may enter it for inspection. Lighthouses such as have never been put on a schooner before take the place of the old-fashioned lightboxes.



ONE OF THE STEAM WINCHES USED ON THE THOMAS W. LAWSON.

SUGGESTIONS AS TO THE PREVENTION OF CORROSION OF TAIL-END SHAFTS.—II.*

BY JOHN BODDY.

Adjourned Discussion.

The Chairman, Mr. Aisbitt, said the first point which struck him in considering Mr. Boddy's appliance was the simplicity with which the oil was applied, once it entered the stern tube, by the outside water pressure. They were told in the paper that when the engines were running full speed ahead, ten minutes after the oil was emptied into the top of the iron pipe, the sounding rod indicated the depth of 1 1-2 inches of liquid, the shaft being immersed about 2 feet; that, after the vessel was moored, after coming from Newport to Barry Dock, and the engines were at rest, the sounding rod indicated a depth of about 2 feet of liquid, this corresponding with the shaft's immersion. This, so far as he knew, was the first occasion which had proved a semi-vacuum in the stern tube, the vessel going full speed ahead. Mr. Boddy put in a pipe to reduce that vacuum, so that they were led to believe that there might have been a greater vacuum even than what Mr. Boddy found. Unfortunately, the paper did not say whether the vessel was loaded when going full speed ahead; but whether loaded or in light trim, he was inclined to think that the semi-vacuum would not be increased to any extent, that there would be practically the same centrifugal action in the way of the stern tube. Going ahead they got the same vacuum, and going astern they naturally forced the water inward. He recalled the recent case of a vessel which had been ashore four or five hours upon a pebbly beach. She was driven astern for about six hours, with the result that the vessel picked up pebbles, and the liner was cut down from about 1-2 to about 3-16 inch, thus showing the force of the propeller action was inward.

Mr. Henderson, while agreeing that lubrication was a very good thing, believed that the best method of preserving shafts was to fit a continuous liner with a very short tube and cover the shaft and the tube all over with one liner. In this way they got practically a parallel shaft. He was not in favor of running any shaft on a white metal bush. As to Mr. Boddy's appliance, he did not think it was a good one without an outer gland.

Mr. Roberts said Mr. Boddy was the first to take steps to ascertain what really had been going on in the tube. He thought Mr. Boddy's experiment of testing the depth of liquid on the shaft confirmed what the chairman had said about a partial vacuum taking place. In some experiments conducted some years ago to ascertain whether the propeller was effective or not, it was found that a partial vacuum was formed at a point in front of the propeller, apparently due to the screwing action of the propeller giving a tendency to draw the water away from the shaft through the effort of propulsion. This would account for the sudden drop in the tube which Mr. Boddy fitted, and also explained the oil getting down to the shaft. It would be naturally expected that when the oil was placed in the tube it would, by its specific gravity, float on to the water, but Mr. Boddy had discovered that the water left the tube and the oil followed its way downward. Mr. Boddy had proved that there was a certain body of dead water remaining in the tube, and this water revolving with the shaft attacked the zinc, and galvanic action was set up, which attacked the iron shaft near

*Paper read before Institute Marine Engineers.

the coupling. He did not agree that an outer gland was necessary. In the first place, he did not think it was possible to keep the gland perfectly tight, and when they stopped the engines and the supply of lubrication the hydrostatic pressure would force its way inward. Mr. Boddy's appliance was fitted to an existing shaft without any alteration of the stern tube. With the ordinary shaft running in lignum vitæ, his method to prevent corrosion was a good one and effective, unless it was intended to prevent the corrosion of the iron of the shaft and not the brasses, which was a secondary consideration compared with the longer life of a shaft. His own opinion was that the continuous liner was a good thing, but the difficulty was as to the length of the shaft. A long brass liner was very deceptive, and a jointed liner was not reliable. A short shaft was a solution of the trouble. This was being adopted on the northeast coast, with the result that they had been able to put in a shaft with one continuous liner, approximately 9 feet over all. This liner was run in a lignum vitæ bush; the lignum vitæ had not to be renewed so often, and a steadier shaft was got all through; and, of course, the corrosion question was eliminated. They had too long taken it for granted that there had been a separation of water there. Certainly oil would float to the surface, but it could not float if there was no water to float on.

Mr. George Walliker, on the question of vacuum, said some years ago he was in charge of some experiments for the late Mr. Parker, of Lloyd's, who was specially interested in the fitting of propeller blades. A small copper plate was fitted down the stern post to the body opposite ahead of the propeller, with a vacuum gage. It was a cargo boat trading between London and Hamburg, and on the trial run they got from 7 to 10 inches of water showing on the gage. So that there was certainly a vacuum at the stern tube end in front of the propeller.

Mr. Boddy, in reply, said, with reference to the observations of Mr. Simpson at the previous meeting, that the shaft alluded to in the paper had been running for six years and nine months, and the oil pipe arrangement was fitted about four and a half years ago. As to the advocacy by several members of an outer gland, in his opinion the oil pipe was sufficient, when fitted as near as possible to the after end of the stern tube, so that the outside water pressure might force the oil forward. The outer gland was not only unnecessary, but might be a source of danger where the lubricant had been neglected, when the shaft would be practically running without any lubrication whatever. His experience showed him that the oil was driven from the point at which it was put into the tube right through to the stern gland, where there was always a soapy run. With regard to the question of Mr. Johnson, the oil pipe was first fitted before the vessel was re-floated out of dry-dock, and about half a gallon of oil was poured down the pipe, since which he had found that half a pint used daily was sufficient. If the shaft was immersed when the oil was put down the pipe, the oil would go no further until some motion took place. With regard to the rubber ring fitted in the recess of the propeller, if it was fitted just sufficiently tight there was little fear of its forcing the propeller away. As to Mr. Watson's remark, oil certainly had a tendency to float outward and upward, but he failed to see how it was going either way against a pressure. Mr. Roberts could not reconcile the figures as to the depth of liquor. In his opinion the difference was attributable to the centrifugal motion of the shaft, combined with the scooping action of the propeller, forming the vacuum of which they had heard so much. As to the continuous liner, so long as the liner could be kept tight he did not suppose there would be much corrosion. As to the kind of oil used, it was the same as that used for lubricating the machinery, viz., Vickers'.

Mr. Robert Duncan described the good results that had followed the wrapping of shafts with marline and red lead, and said that years after this method had been applied he had found the shafts in excellent condition. The red lead seemed to protect the shafts much better than the rubber. They would see from Mr. Boddy's drawing that a cock was wanted at the bottom of the stern tube as well as on the top, and to get all the water out of the tube they must open the bottom cock and draw off the water until the oil began to come, when, presumably, they would have oil all round the shaft. But the fact that all that sand and grit was found in the stern tube showed that it was not so very tight.

Mr. B. T. Vickers (visitor) said he was very much obliged to the honorary secretary for sending him an invitation to attend this meeting, and he was very glad of the opportunity of being present, because the subject under discussion was one in which he took great interest. Mr. Boddy's experience appeared to be that putting oil into the stern tube had lengthened the life of the lignum vitæ in the stern bush. In the course of his business he (Mr. Vickers) had come into contact a good deal with steamers belonging to Continental owners; and so far as the steamers of Sweden, Norway, and Denmark were concerned, there were very few which were not running their tail shafts in oil, and a broken tail shaft was a thing practically unknown. The United Steamship Company of Copenhagen owned about 130 steamers, the whole of which ran their tail shafts in oil and they never had a break. Most of them were linerless shafts, running in cast-iron bushes, and the running of the shafts in oil was a great success. He instanced also the case of a large screw tug owned in the north of England, which was built in 1885, which had an iron shaft fitted with brass liners and running in a gunmetal bush, the shaft of which had been run in oil. About two years ago this boat was overhauled, when the shaft was found to be in perfect condition, the original tool marks being still visible on the part between the two liners. The wear on the brass liners was exceedingly slight, considering the fourteen years the shaft had been at work, only amounting to about 1-8 of an inch. New liners were fitted in the shaft, and it was replaced in the steamer and appeared likely to run for many years more; the splendid condition of the shaft being undoubtedly due to the fact that it had been run in oil from the commencement. After referring to several other points of practical interest in connection with the working of tail shafts, Mr. Vickers called attention to the importance of using in the stern tube only oil which was practically free from acid. He explained that some oils contained a considerable percentage of acid, and that an acid oil was liable to set

up galvanic corrosion in the same way as a solution of acid in water. He also pointed out that the action of sea water, which was a solution of chloride of sodium; upon the brass liner in contact with the shaft in the stern tube was exactly the same as that which took place in the battery of an electric bell with two different metals in contact in a solution of chloride of ammonia, and emphasized the importance of keeping the sea water entirely out of the stern tube. He said the best way to keep the sea water out of the stern tube was to keep the tube quite full of oil, this method having the further advantage that it effectually lubricated both the stern bush and the stern gland. The difficulty then arose of keeping the oil in the tube. Mr. Vickers exhibited a new patent stern tube gland which his firm had invented for this purpose.*

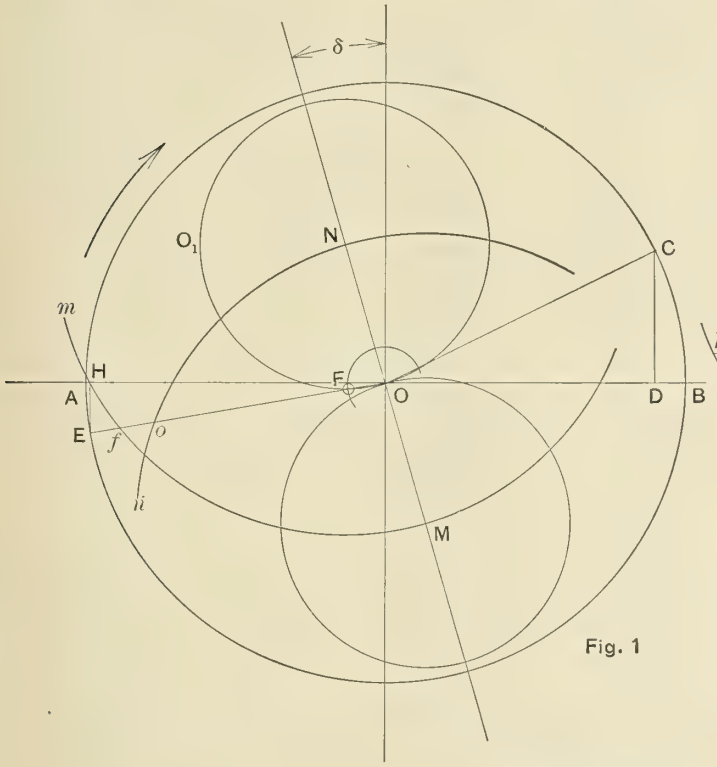


Fig. 1

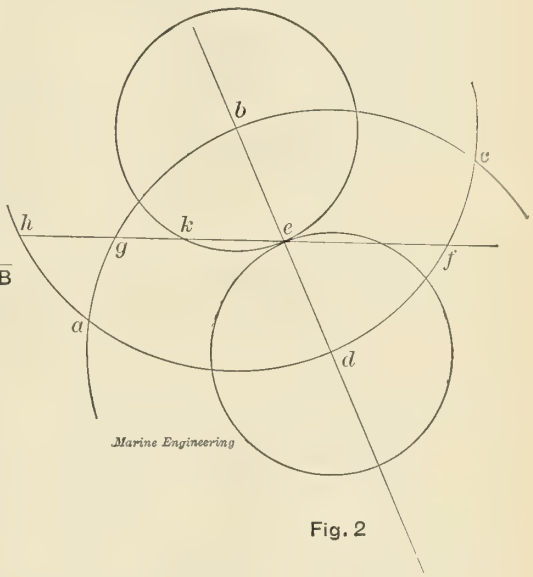


Fig. 2

THE ZEUNER DIAGRAM.

A Point in Connection with the Use of the Zeuner Valve Diagram.

BY N. AKIMOFF.

Zeuner's Diagram is one of the best known and is very often employed because it is both simple and very clear. And yet we know that many designers are not quite satisfied with it, as it is often impossible to take from it all the dimensions with a sufficient degree of accuracy. Therefore the diagram must be drawn in very large scale—for instance, three or four times larger than the full size. This is not necessary, for the accuracy depends entirely upon the manner in which the construction is made. The purpose of this note is to call attention to the very simple and useful method described by Professor M. Boulvin in his treatise on applied mechanics.

The diameter, *A B*, Fig. 1, represents the stroke, and the circumference, *A B*, the path of the crank pin. The size of this diameter is entirely immaterial for us. We can take *A B* = 6 1-4 inches or 100-16 inches. Then every 1-16 inch on the diameter is equal to one per cent. of the stroke. For instance, on this diagram we have the cut-off at 95 per cent. of the stroke. Now, if the angle of lap and the lead are very small the angle of intersection of the line *E O* with the circumference O_1 is extremely small, and it is almost impossible to take with accuracy the dimension *F O*, which is the steam lap. On the diagram, Fig. 1, the angle δ is 16 degrees, and the steam lead equals 1 per cent. What is the lap? May be 3-8 inch, may be 7-16 inch. Now, suppose we draw the circumference *n N* from the center *M*, and the circumference *m M* from the center *N*. Then *fo*—*i e.*, the portion of our line *E O* between these two circumferences *M m* and *N n*—is exactly equal to our lap *F O*, and we can take it directly and not pay any attention to the portion *F O*, which is difficult to measure. The reason for this may be seen by reference to Fig. 2, where *abcd* is a symmetrical figure and *e* is its center of symmetry. Then *ge* = *ef;* but *ef* = *hk*, because they are both symmetrical parts of the chord *hf*. Then *ge* = *hk*, or *ge* — *gk* = *hk* — *gk*, or *ek* = *gh*. We can therefore take our lap simply between these two circumferences with a high degree of exactness. In this case it is found equal to 11-32 inch.

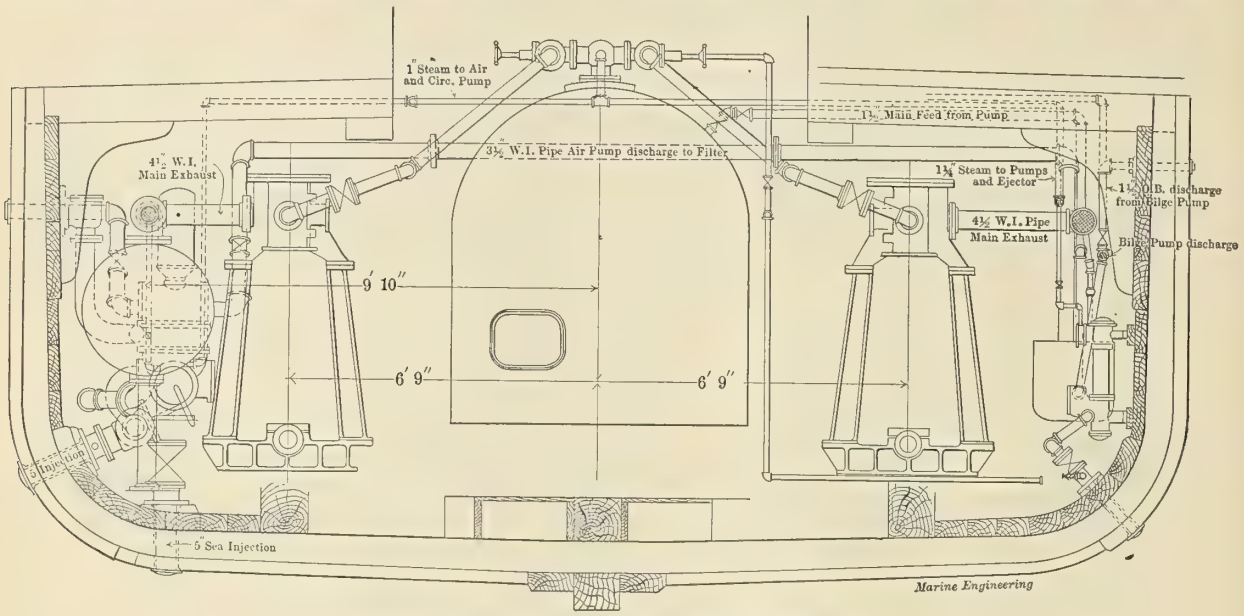
*For description see MARINE ENGINEERING for April, 1902.

New Service to Europe.—It is stated that a new service will soon be established from Boston to European ports by the New York, New Haven, and Hartford Railroad Company. The first line to be started will be to Antwerp, the vessels for which, it is understood, are to be furnished by the Ellerman Line.

NEW STEAMER FOR THE PHILIPPINES.

The first Boston-built boat for traffic with our new Oriental fields, the steamer *Concord,* recently sailed for Manila to engage in the lumber trade in the Philippine Islands. She was built by William McKee for the Boston and Iloilo Company, which is composed of Boston and Concord merchants. She is to be propelled by two compound engines in addition to sail power. The vessel is very strongly built, more so than is customary, and embodies some novel features of design. The frames are of live oak, 24 inches centers, 8 inches molded, and 6 inches sided, doubled, making 12 inches. The bottom planking is 3 inches, the side planking 4 inches, and the ceiling 5 inches. The spaces between frames are filled solid the whole length of the boat from the keel to the beginning of the bilges. She is coppered to the load water line and will carry a dead weight of 300 short tons. The *Concord* is fore-and-aft rigged, with no bowsprit, and the masts are heavy, being designed essentially for hoisting purposes. On the forward one is an 80-foot boom, and on the mainmast a 50-foot boom is arranged for handling the cargo.

The stack is 50 feet above the grate and so arranged


1" Steam to Air and Circ. Pump
1½" Main Feed from Pump
3½" W.I. Pipe Air Pump discharge to Filter
4½" W.I. Main Exhaust
1¼" Steam to Pumps and Ejector
1½" O.B. discharge from Bilge Pump
4½ W.I. Pipe Main Exhaust
Bilge Pump discharge
9' 10"
6' 9"
6' 9"
Injection
5" Sea Injection
Marine Engineering

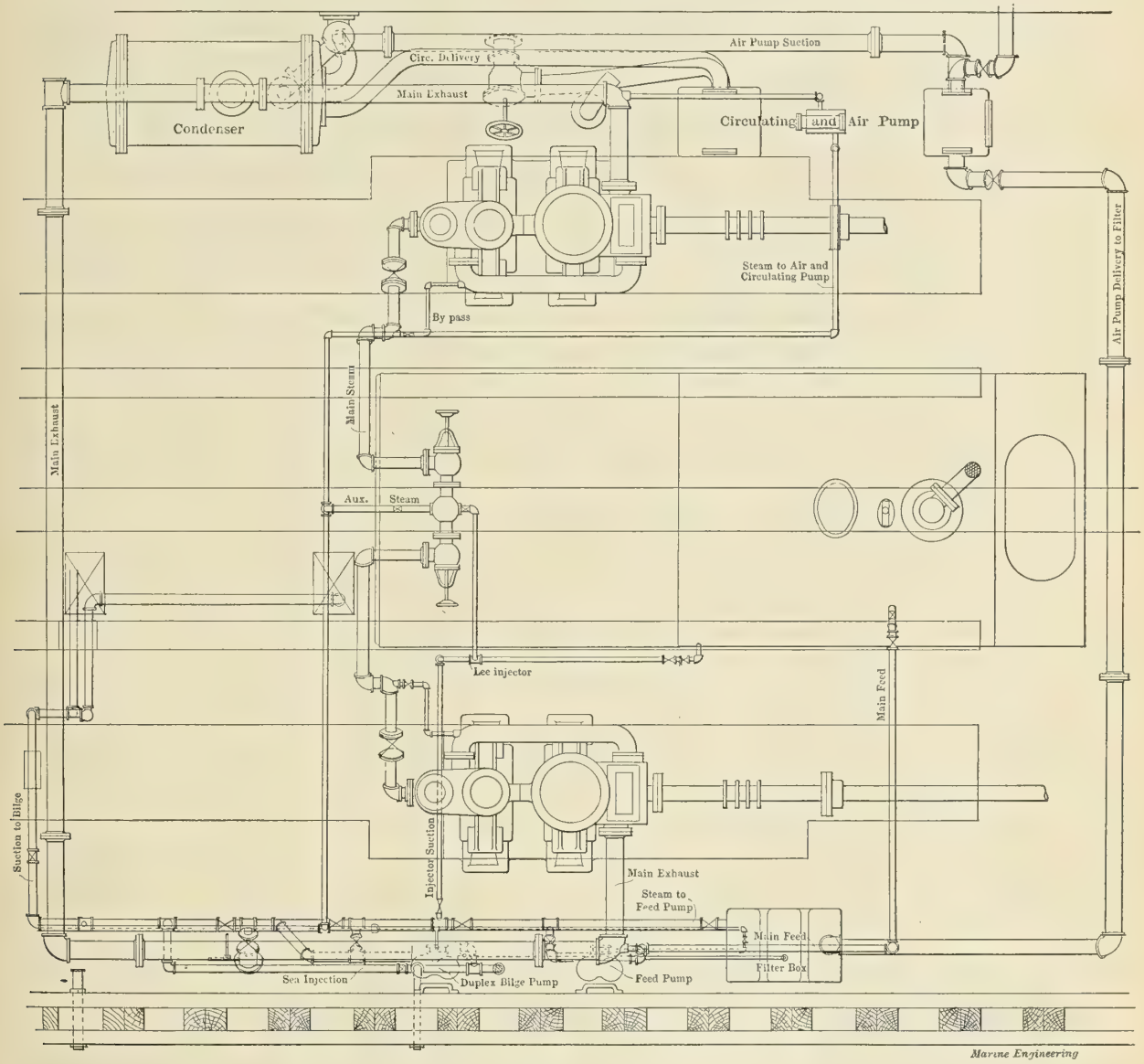
SECTION IN ENGINE AND BOILER ROOM, STEAMER CONCORD.

LIST OF PIPES.

Location.	Material.	Size.
Main steam	Wrought iron	2½ ins.
Auxiliary steam	" "	1½ "
Steam to injector	" "	1 in.
" " air and circulating pump	" "	1 "
" " feed pump	" "	½ "
" " bilge	" "	½ "
" " ejector	" "	1¼ ins.
" by-pass	" "	¾ in.
" for blowing out strainers	Wrought iron, with brass nipple in nozzle	½ "
" to whistle	Wrought iron	1¼ ins.
Main exhaust	" "	4½ "
Exhaust from air and circulating pump	" "	1¼ "
" " feed pump	" "	¾ in.
" " bilge pump	" "	¾ "
Suction air pump	" "	4 ins.
" circulating pump	Copper	5 ins. No. 13 B. W. G.
" feed pump	Galvanized iron	2 ins.
" bilge pump	" "	2 "
" from fresh-water tank	" "	2 "
" e ector to bilge	" "	2 "
" injector	" "	1 in.
" from filter	" "	2 ins.
Discharge from air pump to filter	Wrought "	3½ "
" " " " overboard	" " brass pipe through hull	3½ "
" " circulating pump to condenser	Copper	4 ins. No. 13 B. W. G.
" " condenser overboard	"	4 " No. 13 B. W. G.
" " feed pump	Brass	1½ ins.
" " bilge pump overboard	Galvanized wrought iron pipe. Brass through hull	1½ "
" " " " on deck	" iron	1½ "
" " ejector	Brass	2½ "
" " injector	"	1 in.
Pipe for wetting ashes	Galvanized iron	½ "
Whistle pipe	Wrought iron	1¼ ins.
Escape "	Copper	4 ins. No. 16 B. W. G.
By-pass pipe	Wrought iron	¾ in.

as to be easily taken down when the craft is under her own sails. The general dimensions are as follows: Length on keel, 122 feet; length over all, 130 feet; beam, molded, 25 feet; beam, over guards, 26 feet 4 inches; draft, loaded, 8 feet; depth of hold, 10 feet.

abreast of each other. As will be seen by referring to the accompanying pipe plans, the boiler is on the center line of the boat, and the twin-screw engines on either side, 6 feet 9 inches from the center. The boiler is of the locomotive type, 6 feet 6 inches in

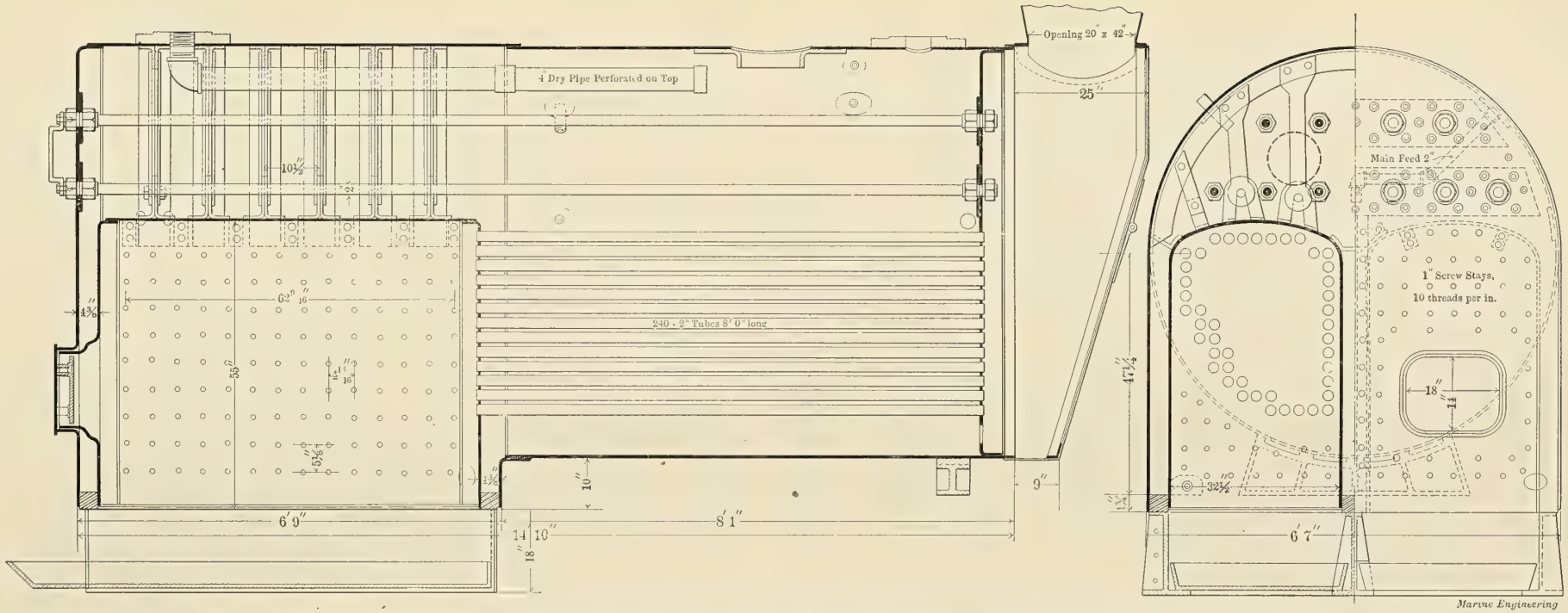


PIPE PLAN OF THE STEAMER CONCORD, ENGINED BY THE ATLANTIC WORKS.

	Draws from	Discharges to
Circulating pump	Sea	Through condenser overboard.
Air pump	Condenser	To filter box and overboard.
Feed pump	Filter, tanks, and sea.	To boiler.
Bilge pump	Bilge, tanks, and sea.	Overboard, on deck, and to tanks.
Inspirator	Tanks, filter, and sea.	Boiler.
Ejector	Bilge	Overboard.

It is the arrangement of the machinery, however, which attracts especial attention. The boiler and engines were built by the Atlantic Works, of East Boston, and because of the vessel's large beam are placed

diameter by 14 feet 10 inches long. There are two separate furnaces, each leading into one hundred and twenty 2-inch tubes. The grate surface is 32 1-2 square feet, and the total heating surface is approximately



LOCOMOTIVE-TYPE BOILER FOR THE STEAMER CONCORD, FOR THE PHILIPPINE TRADE.

1,205 square feet, made up of 1,000 square feet in the tubes, 171 square feet in the furnaces, and 37 square feet in the smoke box. The ratio of total heating surface to grate surface is 38.6. The boiler is fired from the forward end. The engines are abreast of the boilers, as above stated, and the high-pressure cylinders, which are forward, are fitted with a piston valve. The arrangement of piping is of interest, as can be seen by following out the accompanying drawings. Steam is taken from a 4-inch dry pipe in the forward end of the boiler, and by T is carried to the two 2 1-2-inch main steam pipes, right and left. The exhaust from the two engines is carried to the condenser on the starboard side, where is also placed the circulating and air pump. The air pump delivers to the filter box on the port side, and nearby is the main boiler feed pump. Water in the filter box is heated from the pump exhaust. The principal dimensions of the machinery are:

Diameter cylinders	9, 18 in.
Stroke	12 in.
Condenser surface	328 sq. ft.
Revolutions	180
I.H.P.	175
Diameter propellers (bronze)	5 ft. 6 in.
Number of blades	4
Pitch	5 ft. 0 in.
Area of each propeller	10 sq. ft.

Petroleum in South Australia.—It is reported that oil of a good quality has been discovered in the southeastern district of Australia. At present oil is imported from Asia and America. In view of the immense coal fields of Australia, which have been recently estimated at 240 billion tons, that continent is well provided with fuel.

Trial of the Siberia.—The new steamship *Siberia,* built for the Pacific Mail Steamship Company, recently underwent a very successful sea trial, when she is reported to have made a maximum speed of 21 knots. The *Siberia,* with her sister ship the *Korea,* which were built at Newport News, were described in MARINE ENGINEERING of May, 1902.

STEAM TURBINES.*

BY HONORABLE C. A. PARSONS.

After referring to the trials of the *Viper* and *Cobra,* the two destroyers which were unfortunately wrecked, Mr. Parsons gave some interesting particulars on the early history of his invention. The compound turbine was first used in England in 1884 for driving dynamos. Three hundred and sixty plants of from 4 to 120 horse power, aggregating 5,000 horse power, were in use in 1890. Six years later 600 turbines of 40,000 horse power had been sold, the largest unit being of 600 horse power. At the present day there are 800 turbo plants in use, aggregating 200,000 horse power, the largest being 3,000 horse power. Two years ago Messrs. Brown, Boveri and Company, of Baden, Switzerland, took up the manufacture of compound turbines and sold 20 plants of 29,000 horse power, the largest of 5,000 horse power. The British Westinghouse Company has lately contracted with the Metropolitan and District railway companies for the supply of ten turbo alternators of 5,000 horse power, and several plants of moderate size have also been built by the Westinghouse Machine Company, of Pittsburg. The total aggregate of turbines at work and on order of the compound parallel-flow type, for generating electricity in England and on the Continent and elsewhere, was not far short of 300,000 horse power. Turning to the question of economic results, the author said that the lowest steam consumption so far recorded had been 17.3 pounds per kilowatt hour, with a 1,000-kilowatt continuous-current plant, one of several built for the Newcastle and District Electric Lighting Company. This figure corresponded to about 10.2 pounds of steam per indicated horse power hour. There seemed no doubt that still lower steam consumptions per horse power would be reached in turbines of large size working with superheated steam and a good vacuum. Several turbine plants had been tested after being at work for a considerable time, in order to ascertain if any increase of steam consumption occurred with age, and in all these cases no observable increase could be detected.

Reverting to the marine steam turbine, the paper stated that at present there have been seven vessels fitted—the *Turbinia,* the destroyers *Cobra, Viper,* and *Velox,* the Clyde passenger boats the *King Edward* and *Queen Alexandra,* and the yacht *Tarantula.* The large yacht *Lorena* will be completed this autumn. The destroyer *Eden* and the third-class cruiser *Amethyst* would be completed in 1903, and within the last few weeks orders for two turbine cross-channel boats of about 8,000 horse power had been placed with Messrs. W. Denny and Brothers. One of these vessels is for the Chatham and Dover Railway, for the Dover and Calais route. The total aggregate indicated horse power of the above-mentioned vessels was 82,900 horse power.

The question of coal consumption was next considered, and the author then described the method of economizing fuel at low speeds by the fitting of additional small engines. The excellent performance of the Clyde passenger steamer *King Edward* was next referred to by the author. These particulars also have already been given in these pages. Mr. Parsons quoted the remarks of Mr. James Denny at the launch of the *Queen Alexandra,* as to the results of experiments and trials made with the *King Edward.* If the *King Edward* had been fitted with balanced twin triple-expansion engines of the most improved type, and of such size as would consume all the steam the existing boiler could make, the best speed she could possibly have obtained would have been 19.7 knots, against the 20 1-2 knots actually done by the *King Edward,* showing an increase in speed of eight-tenths of a knot. This difference corresponded to a gain in indicated horse power in favor of the turbine steamer of 20 per cent. It would hardly have been possible to drive the *King Edward* at 20 1-2 knots with ordinary engines, owing to the extra weight of the machinery and the necessarily increased displacement. The attempt to do so could only have resulted in the speed being obtained at an enormously increased first cost and a ruinous expenditure of coal and the like on service. Referring to the question of coal consumption, the results of the *King Edward* on service had been compared with the *Duchess of Hamilton,* and from the comparison it had been found that the *Duchess of Hamilton,* at 16 1-2 knots, burned 16 tons, and the *King Edward,* at 18 1-2 knots, burned 18 tons. The *Duchess of Hamilton* had only compound engines; by the use of triple engines her consumption could be reduced; but even with triple engines, if she were to be driven at 18 1-2 knots on service, her consumption would have been over 22 tons, as against 18 in the *King Edward.* This corresponded to a saving of about 20 per cent. in favor of the latter vessel. The figures were based on the assumption that the *Duchess of Hamilton* was left as she was as regards displacement, but, as her speed was only 18 knots on trial, the greater displacement necessary to carry the extra weight of machinery for the higher speed would have resulted in a considerable increase in the coal consumption of 22 tons. The paper concluded by narrating the advantages that would follow the adoption of the steam turbine system of propulsion in vessels of large size, such as Atlantic liners, cruisers, and battleships. The benefit, the author stated, would be greater than in the case of smaller vessels, for the large turbines that would be suitable to such vessels would be cheaper to build, lighter in weight, and occupy less space in proportion to power. The design of such large turbines presented no difficulties beyond those that had already been successfully disposed of in the case of smaller vessels; and the greater size facilitated the introduction of important refinements for reducing coal consumption.

DISCUSSION.

Professor Unwin remarked that, as the larger the machinery the easier it became to operate, one could hardly conceive the limit of the steam turbine for purposes of ship propulsion.

Professor Dunkerley said that he had assisted in testing a steam turbine in 1897 and found it gave satisfactory results. By a comparison of the observed results of the *Turbinia,* there was a loss in efficiency of the whole mechanism of propulsion. The consumption of steam was 29 pounds per effective horse power per hour, and with a propulsive coefficient of two-thirds that would work out to 19 pounds per horse power. As Mr. Parsons attained a horse power on 15 pounds of

*Extract of paper and discussion read before the British Association for the Advancement of Science, held at Belfast.

steam, there was evidently a loss. From this it would seem that the *Turbinia* crossed at an efficiency of about 50 per cent., whereas the ordinary screw was 68 per cent.

Professor Hele-Shaw stated that Mr. Parsons had found the best way of using steam was by the parallel-flow turbine, which gave an increased economy of 15 per cent. These results were not reached, however, until the most extensive series of trials and experiments as but few people would have undertaken. He had seen details of a test made with the steam turbine against a Corliss engine at Elberfeld, where the turbine had shown considerably higher economy.

Mr. Parsons closed the discussion by stating he had superheated steam for running the turbine as high as 200 degrees, the pressure being 150 pounds to the square inch. He estimated the gain in efficiency due to superheating to be about 1 per cent. for every 10 degrees of superheat. The gain was rather higher for the first few degrees, but the figure stated was about the average. He had not gone very high yet; but he saw no reason why the steam should not be superheated up to any temperature within reason. It would, however, be necessary to keep the metal of the cylinder of uniform section, as any irregularity in the thickness would tend to bend the casting. He had been asked about high lifts for the reverse turbine. In New South Wales pumps were placed in series, and raised water a distance of about 700 feet, each pump working against a head of about 240 feet. The efficiency of screw propellers was a difficult subject. In the *Turbinia* he made an assumption that there was 55 per cent. between the indicated and propulsive horse power. That was on the basis that 14 1-2 pounds of saturated steam at 200 pounds pressure at the engine was used per indicated horse power per hour. If the augmented resistance due to the friction of the shafts, the under-water fittings connected with the propeller, the water on the blades, etc., were 10 per cent., that would bring the efficiency of the propellers to 65 per cent. That agreed with the tank experiments made by Messrs. Denny at Dumbarton, with a model from which the under-water fittings were removed. The slip rates of a screw would generally be about 22 per cent., but in the *Queen Alexandra* model it was 30 per cent. with flat blades. It should be noted that the velocity of the blade tips with the screw of the *Queen Alexandra* was not greater than that attained with the screws of third-class cruisers. The reversal of the marine turbine was effected, as stated, by separate blades, which ran in vacuum when not in work. It could be arranged that the blades would work in either direction by the reversal of the flow of steam, but this would mean that the form of blade would not be efficient for either direction of rotation. It was, therefore, best to shape the blades so that they would give the best results for going ahead, and have a separate set for the sternward motion of the ship. In regard to efficiency it might be added that the turbine had been tried against a Sulzer engine of the same power. At three-quarters load the two were equal; above that, the turbine had the advantage; but below, the reciprocating engine was best. The turbine, however, used from 1 to 2 per cent. less oil than the other engine, which would be about 16 per cent. on the value of the steam. At Newcastle station the use of steam turbines gave a saving which averaged 5 pounds a week in value.

Methodical Stoking for Large Installation of Water-Tube Boilers.

BY DAGNINO ATTILIO.

All who have had charge of the trials of a large warship fitted with water-tube boilers (or, indeed, with any type, although the difficulty is perhaps more accentuated with those of the water-tube type) will have experienced the great trouble there is in obtaining regular firing and a uniform charging of the furnaces, so that the evaporation may be of the same degree of intensity in the different furnaces, and that this intensity may be varied in precisely the proportion required to obtain the power to be developed by the engine. It is very clear that if it is left to the judgment of the leading stoker as to the quantity of fuel to be introduced into the furnaces under his charge, he in turn leaving it pretty much to the stokers themselves, they will naturally work by momentary indications of the pressure gages on the boilers in that compartment and at that particular instant, thus causing considerable fluctuation of the steam pressure from one period to another. Again, the stokers in one compartment, under an active leader, will fire up vigorously their boilers, giving the full amount of steam they are capable of, while in another compartment, under a less active leader, the stokers, seeing that the pressure is maintained, will content themselves with putting on just enough coal to keep up appearances, and the boilers in such compartment will consequently render but a small proportion of work, compared with the others. Among other bad consequences of unequal firing, perhaps the most serious is that, if the two compartments worked at such different rates of combustion are served by the same funnel, the boilers with grates partly uncovered will take most of the draft; for the air, naturally taking the line of least resistance, finds its way more easily through the grates with a small amount of coal on them, or partly uncovered. On the other hand, the draft is less in the boilers that are being vigorously fired and have the grates well covered, so that in the latter the combustion takes place under unfavorable conditions.

These troubles are well known to all engineers who are called on to carry out trials of large steamers, and are naturally more prominent in those navies of the world which are dependent on conscription for their stokers, thus involving continual change and little preparation before they are sent on board as able-bodied firemen. These troubles have also of late been intensified by the introduction of water-tube boilers. To obtain good results with boilers of this type it is very necessary to keep the grate surface completely but lightly covered with fuel, and this is altogether impossible save with regular and uniform firing. The first thing to be done, therefore, to insure the necessary regularity in firing is to calculate the quantity of fuel to be put in each furnace per unit of time, and then to decide what interval of time between the periods of firing is best adapted to the conditions in hand. It is then only necessary to work out a scheme for insuring the regular charging of the furnaces with the amount decided on at the intervals selected.

For each different intensity of evaporation there will, of course, be a different interval of time, and the most

convenient way of carrying out the change from one rate of evaporation to another is to draw up a table showing the different rates of firing corresponding to the indicated horse power required or to the number of revolutions to be made by the engines. These rates of firing may then be divided into a certain set of grades, so that when a given power or speed is required it is only necessary for the chief engineer to give the order for a certain grade, and the watchkeeper finds readily in the table what the charge should consist of and at what interval it should be fired.

rake, will appreciate how difficult it is to bring them to an understanding of what is required of them under the changed conditions found in water-tube boilers. It is perhaps even more difficult to induce the leading men accustomed to the old method of firing to realize the absolute necessity of implicit obedience upon the instructions given them. In the case of the *Garibaldi*, after the tables were made out it depended upon the leading men to give the signal at the commencement of each period. It was found, however, almost impossible to induce them to be sufficiently particular in work-

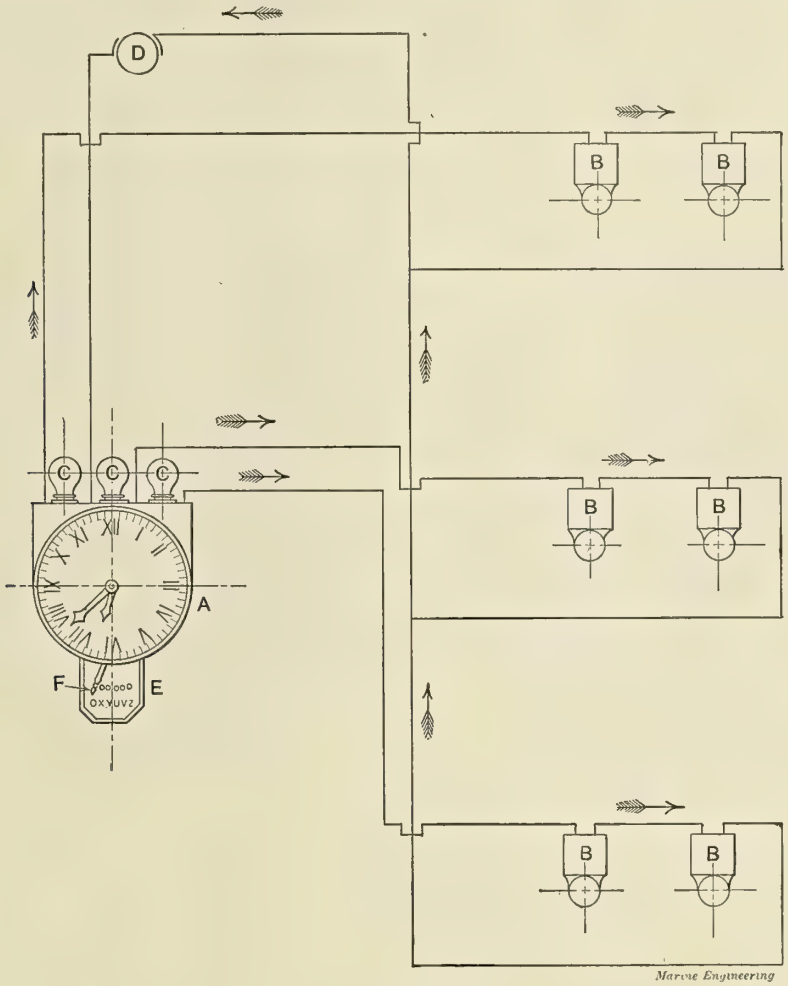


FIG. 1.

On the trials of the first vessel of the *Garibaldi* type fitted with water-tube boilers, as soon as it was seen that regular and equal firing was necessary to a proper development of the power, a clock with a second hand was fitted in each compartment of the stokeholes, and tables as mentioned above were prepared for the use of the leading men, each of whom was furnished with a whistle with which to signal the moment when the firing of the furnaces under his charge should commence.

All who have had to do with training for water-tube boilers stokers previously accustomed to piling up the coal in the front of a cylindrical furnace, letting it burn partly through and then pushing it back with a

ing to the desired periods of firing, and it soon became evident that it would be of great advantage if the human and doubtful element could be eliminated and the signals given automatically.

On these trials, the stokeholes were in charge of Cav. L. Perroni, the manager of Messrs. Ansaldo's steel works near Sampierdarena, and, realizing the need, he designed an apparatus for this purpose. This proved itself so satisfactory that those who have had experience recognize it as an actual necessity wherever water-tube boilers are fitted on board ship, as well as a valuable auxiliary if fitted with cylindrical boilers. The arrangement is shown in Fig. 1. *A* is a clock fitted in the engine room, and which replaces the clocks fitted

in the different stokeholes, and in connection with which is the regulating apparatus, which may be considered as analogous to the chief engineer giving his orders as to the periods for the different rates of firing. *B B* are electric bells fitted in each of the stokeholes (in this case six) to give the signals to commence firing.

On the top of the clock in the engine room is a series of glow lamps, *C C C*, in connection with the different circuits, and which light up while the current is passing, thus showing in the engine room if the circuits are in good order and the apparatus doing its duty. The current is preferably derived from the circuit for electric lighting, or, if this is not always charged, a series of cells can be provided, as at *D*. The different grades are marked on an index plate, *E*, under the clock, *F* being the regulating handle, with a pin to hold it in any desired position. As many grades may be arranged for as may be considered necessary, but in practical use it is

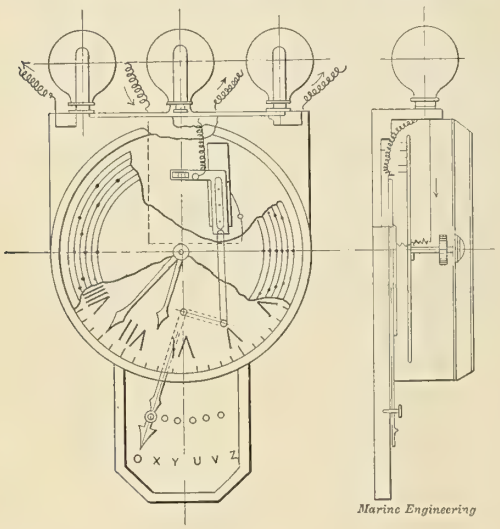


FIG. 2.

found that, as a rule, five will be found sufficient besides the position *O*. When the handle is placed at this the current no longer passes, and as the bells cease to ring all firing in the stokeholes is suspended. When the signaler is at work, the bells ring at the end of each desired interval of 20 seconds. The clock axle that carries the minute hand carries also a quadrant, which moves with the axle. On this quadrant and on circular and concentric zones are fitted small pins.

We may suppose a circular zone on which are fixed five pins. The quadrant, following the movement of the minute hand, will in one hour make one revolution of 360 degrees, and consequently in one hour the pins pass successively on the above-said plane at the regular interval of 12 minutes—that is, each pin will pass a given point every 12 minutes. If, then, a suitable contact piece is fitted, the passing of the pin will determine the closure of the circuit, and the signal will follow. We have supposed the contact piece fitted at the point where the circumference has five pins; but if, by means of a rod, this piece is moved to another zone with a different number of pins, then the interval between the signals will correspond to the number of pins in this zone, and in this way any desired arrangement may be made.

One great advantage of the apparatus is found in the fact that it leaves the leading man absolutely free to devote his full attention to his other duties. In modern cruisers, also with water-tight bulkheads carried up above the level of the water line, and no doors for communication between the engine and boiler rooms, it is necessary to transmit orders by voice-pipes to the stokeholes, of which there may be as many as twelve or more in a 20,000 horse-power vessel, so that it is no easy matter to communicate the frequent changes of speed to the boiler rooms when cruising in company. With the proposed method of communication, however, every possibility of error or misunderstanding is at once removed, and the signals are made with regularity and certainty.

With this method, the chief engineer has the rate of firing entirely under his control in the engine room, and when orders from the bridge are given to alter the speed of the engines, he has only to shift the key slightly to the new "grade" required, and without loss of time or possibility of error the rate of firing adapts itself to the new rate of speed. The stokers, too, find it an advantage, and after a little experience with it their shovels go almost automatically to the coal as soon as the bell is heard to give its warning, and they find firing regularly and equally much less fatiguing than in the old haphazard way. In practice it is also found to reduce the anxieties of water-tending; for, with absolutely regular firing with equal charges, the water level is maintained at an even height throughout, without any trouble whatever, even with hand regulation; and, indeed, it is found seldom necessary to touch the feed-regulating valve at all so long as the same rate of firing is maintained. An apparatus as above described was constructed and fitted on board the Italian *Garibaldi* (No. 4) and the Turkish *Messoudyèh* in time for the official trials, and was found admirably to fulfill the purpose for which it had been designed. Its use overcame all the difficulties that had formerly manifested themselves in obtaining regular and equal firing, with the result that the trials were very successful. It was afterward retained on board for regular use, and the engineers have reported that it was simply invaluable and also conducive to economy of fuel.

American Shipbuilding Company.—At the recent annual meeting of the American Shipbuilding Company the official statement showed its affairs to be in a most prosperous condition. The surplus earnings for the year ending June 30 were $1,184,257.52—this after paying 7 per cent. dividend on the preferred stock of $553,000, in addition to charging $420,293.55 for depreciation, putting aside $200,000 for improvements at Detroit and other places, and reserving $150,000 for the payment of a purchase mortgage on the Buffalo plant, thus freeing all property interests from mortgages or other encumbrances. The surplus for 1901 was $1,173,676.67, and for 1900 it was $568,665.85. The vessels built during last year numbered forty-one, with a carrying capacity of 198,500 net tons. The vessels now under construction number thirty, with a carrying capacity of 139,000 tons.

ETCHED SECTIONS OF STEEL FROM A BROKEN CRANK PIN.

The microscopical examination of steel and other metals with a view to the study of their mechanical properties as indicated by their crystalline and microscopic structure has in recent years acquired an increasing importance. For years the fact had been recognized that different samples of steel, for example, having the same chemical composition, and on chemical analysis rated as practically identical, might show surprising differences in physical and mechanical properties. It was clearly seen, in consequence, that some means of analysis beyond the chemist's balance must be developed if such differences were to be explained and their causes brought under intelligent control. The most effective and hopeful of such means has been the application of the microscope to the study of the structure of steel and other metals, as shown by the application of suitable etching agents. The appearances thus produced

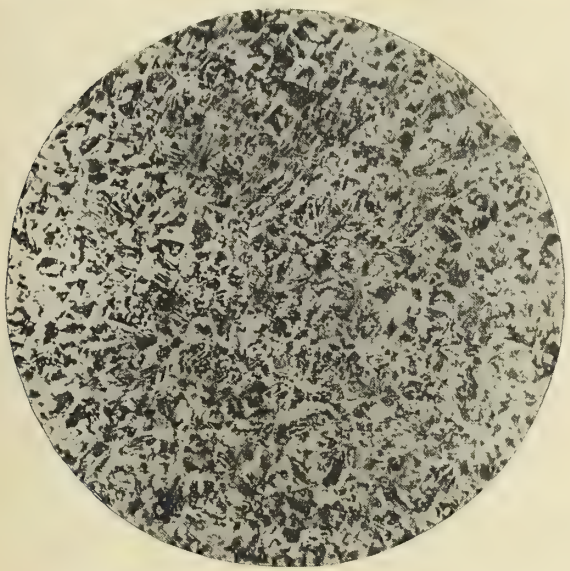


FIG. 1.

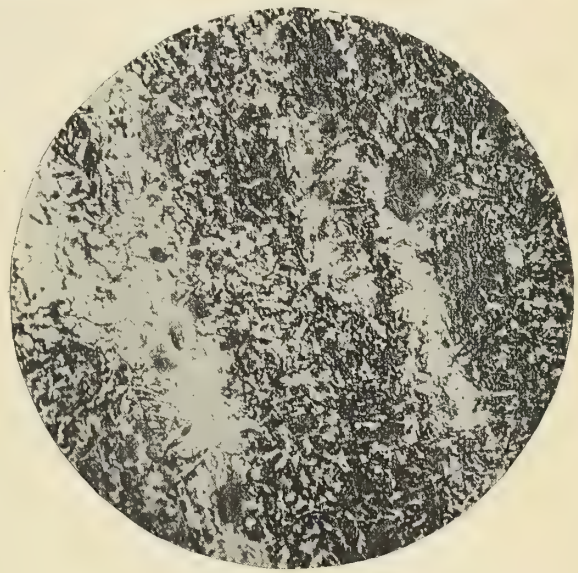


FIG. 2.

have sometimes been referred to as indicating "molecular" structure. This, however, is quite erroneous. Molecular structure is quite beyond the reach of microscopic or any other direct means of examination, and whatever is thus revealed, it is not molecular structure. The means thus available are, however, capable of showing the general characteristics of the crystalline structure, such as the nature, size, and arrangement of the crystals, as well as the general proportion of the metal which may appear to be truly crystalline and that which appears amorphous or non-crystalline. The general distribution of constituents having different properties is also indicated, and a series of varying indications may be more or less clearly made out, many of which may be by experience associated with the characteristic qualities of the metal itself.

The usual manner of developing the internal structure of a sample of steel, for example, is to first prepare a smooth polished surface, which is then subjected to the action of very dilute hydrochloric acid, tincture of iodine, or other etching agent. This agent acts differently on the various constituents of the steel, and in consequence will tend to show up the structure much as the structure of a macadam road is shown up by the action of a heavy rain or stream of flowing water. When sufficiently etched in this manner the surface is submitted to examination by the microscope under a magnification of 50 to 100 diameters or more. By this means the various features above noted may be more or less clearly made out. The relation between the appearance of these etchings and the mechanical properties of the metal is not, however, always clear, and careful study is required in the comparison of such etchings with the observed qualities of the metal before we can pronounce with confidence on the significance of the results obtained.

For purposes of record such etchings may be drawn or photographed, and the recent literature of the subject contains many excellent illustrations of such drawings or photographs, clearly indicating, even to the uninitiated, the excessively complex character of the important engineering metals.

In Figs. 1, 2, 3, and 4 are shown reproductions from photographs made from etchings on steel taken from a fractured crank pin of the steamer formerly known as the *Paris* and now the *Philadelphia*.

Fig. 1 shows a longitudinal section taken at the surface of the shaft and indicates what is considered to be the normal structure of a mild steel.

Fig. 2 is also a longitudinal section taken about four inches below the surface of the shaft, and indicates by the alternate light and dark bands a structure usually considered dangerous in a steel of this character.

Fig. 3 shows a transverse section from the same location as Fig. 2, and indicates by the suggestion of a lattice- or trellis-work pattern a structure usually considered as undesirable or dangerous.

Fig. 4 shows another transverse section from about the same location, but with a somewhat different type of structure.

Our knowledge of the relation between etchings of

metals and properties producing a metal structure liable to sudden fracture under vibratory stress, is far from complete, but, according to Professor Arnold, one of the leading workers in this field, the following appearances indicate dangerous steels:

1. Loose intercrystalline ferrite joints.
2. A trellis-work section in which the bars are ferrite.
3. Cellular structure of any kind.
4. A structure running parallel to the axis of a shaft and consisting of alternate bright and dark bands, due to alternate arrangements of areas of ferrite (white in the figure) and pearlite (dark in figure).

Fig. 2 shows the alternate bands, and Fig. 3 gives a suggestion of a trellis or lattice arrangement as referred to above.

As already noted, these etchings were made from steel taken from a crank pin of the former *Paris*. This crank pin failed in service, due possibly to a poor fit between the pin and crank webs, which allowed the webs to spread, thus giving rise to a periodic stress, which, acting on a favorable structure, as indicated in Figs. 2 and 3, gave rise to the development of fine cracks, which ultimately led to the failure of the pin. It should be noted that fine longitudinal hair-line surface cracks were to be seen on the pin near its junction with the web. This was the only outward evidence that the structure of the pin had undergone serious deterioration. This pin was made of simple carbon steel, and so far as known gave no evidence when new of any peculiarity of structure.

The views shown in the figures are all magnified 65 diameters, and the etchings were prepared in the scientific laboratory of the Bethlehem Steel Company.

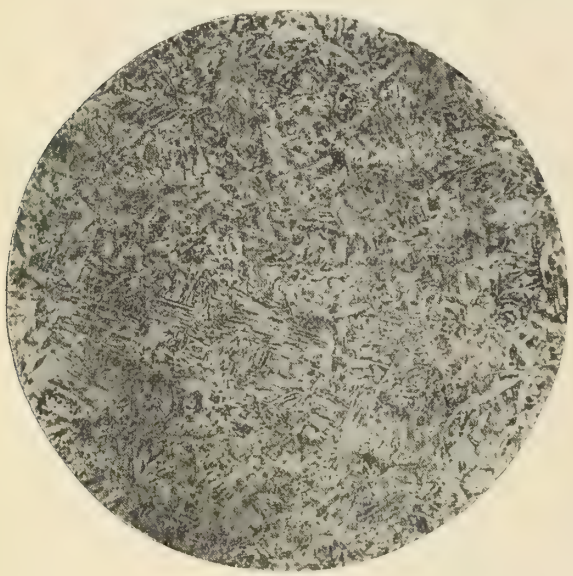


FIG. 3.

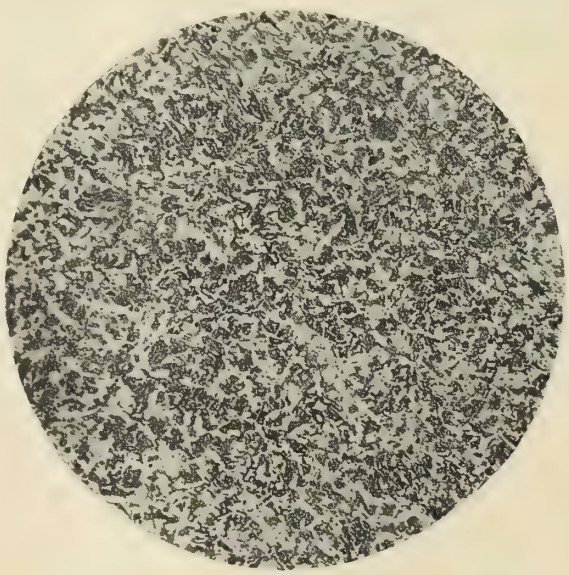


FIG. 4.

New Crafts for British Navy.—The British Admiralty has ordered nine additional torpedo-boat destroyers from private firms. It is stated the speed will be but 25.5 knots and that one of the vessels will be equipped with turbine engines.

MARINE ENGINES ON THE GREAT LAKES FROM A COAST ENGINEER'S POINT OF VIEW.

BY L. D. LOVEKIN.

It having been my pleasure recently to visit the office and works of the American Shipbuilding Company, at Cleveland, O., I thought it a good opportunity to make a comparison of the design as well as the finish of this class of engineering work compared with that of our first-class yards on the Coast.

The first impression that one gets on entering into an investigation of this kind is the very plain appearance of all these engines. If the visit be on shipboard, naturally the top of the engine shows up first, and owing to the cylinder heads and valve chests being painted all over, they naturally present a very plain appearance, especially to one accustomed to the bright work usually employed on the Coast, the latter of which to my mind adds materially to the selling price of a ship equipped with such machinery. This, however, is a practice which has been followed for years, and, with the small force usually available for keeping such work clean on these vessels, seems a necessity. The next point one observes is the use of cast iron grating throughout, and of wrought iron black pipe being used for stanchions and hand rails, with the exception of the top gallery, which is at times made of brass. Owing to the shallow draft of these steamers, there is a comparatively small amount of either flooring or railing used, and this is quite an important item as regards the cost of machinery. The next point we observe is the very plain oiling device used. The main bearings are only provided with a wrought iron pipe extending to the front of the engine, on which a dope cup is attached, such a thing being almost unknown to the engineer of the Coast. The water service, owing to fresh water being used, is of iron instead of brass, as is used for salt water. This also reduces the cost considerably.

The most recent engine design of the Great Lakes deserves considerable credit. In place of using six main

bearings, only four are used. While they are somewhat similar to the engines designed by Mr. John Hyde some years ago, they differ in the arrangement of valve gears. The engine is made very short, and in order to accommodate the valve gear, if of Stephenson type, a rocker shaft is provided so as to bring the M. P. valve gear immediately adjoining that of the L. P. gear, while the H. P. cylinder valve gear is forward. It is evident that the reduction of from six to four bearings also forms a basis for quite a saving throughout. I might add that these bearings are all bored out in place, and thus require very little scraping. The housings are of a very simple design. The reverse shaft, as well as the valve gear bearings, are all cast on the housings and have shaft set in place, and then babbitt is poured around, thus avoiding the machining of these entirely. The connecting rods of the recently designed engines deserve creditable comment, being of the single ended type and of the simplest possible design, almost all the work being done on a lathe. The lower end has a cast steel box of very light design, the box and lower end being in one piece. The upper end has a single brass box slipped into a recess in the connecting rod and made so as to be readily adjusted by means of an inclined block. Taken as a whole, the rod is very creditable both as to design and cost. The crosshead is also a very neat and simple design, being of cast steel finished all over with brass gibs for adjustment on both sides and ends. The piston rod is held in crosshead by a cotter, and the crosshead pin is held in the ordinary manner by means of taper, shoulder, and thin nut on outside.

The crank shafts are usually made with cast steel slabs and look very plain, but answer all purposes. Not even a fillet is provided on the crank pin. So it will be seen that the aim throughout is in the direction of reduced cost. I might also add that in many cases there is only a pinch wheel provided for turning the engines over in port, while we provide a turning engine, which again adds considerable to the cost. The main bearing caps are cast iron, single bolted, but with double bearing on the two inner legs.

The eccentric rods in many cases have cast steel ends for the forks. This I do not care for personally, although the ones I saw looked very well indeed, and in fact several Coast firms are using these ends. The links are very close together, and this greatly reduces the width of fork on rods. This is accomplished by means of using a large brass circular link block and the links passing through same. The design is such as to machine easily, but it makes a very large link-block pin. I might add that in some cases they have made eccentric rods without any yoke whatever, simply a straight rod fitting between the links. This, of necessity, requires more valve travel than ordinarily used, so as to give the required travel of valve at its working point, which puts the eccentric rod off the center of the valve at all times. I might add, while dealing with valve gear, that the piston valves have no false liners in chests. This again reduces the cost considerably, and is not necessary for the proper working of the valve when no small steam rings are used. This, however, has been done by several Coast firms also. They use slide valves for all L. P. valves and build the cylinder without any top cover (simply an outside cover). This avoids the troublesome joint and makes a very simple valve-chest cover. The reversing arms are elliptical in form and very simple. The wrought steel block that carries suspension link is also very plain. Most of the cylinders are of single bottom type. The crosshead guide is of slipper type one side only and of necessity cheaper than the double guide we fit on some engines. They also open up the casting of the housing on the front end and simple rib it. The false guide with water circulation when bolted to housing forms good construction for strengthening. We then notice that there is no expensive surface condenser and no circulating pump required, as the water to the jet condenser is supplied by gravity, and the cost of the jet condenser and air pump is small compared with a surface condenser similar to our practice.

The next important point relates to the shafting. They provide a cast iron tube and make one long outer bearing only of lignum vitæ in brass sleeve. This sleeve is usually made in halves, divided longitudinally as well as being in two lengths, held together by small dovetail pieces, the idea being to be able to renew the bearing without taking propeller wheel off or the shaft out, as they allow enough room from the bulkhead to the coupling forward to enable them to pull the shaft aft with the wheel in place a distance equal to at least one-half the total length of this bushing.

They can then pull bushing out, refill, and then place in position again. This would not be possible in the case of single screw steamers having a rudder post, for in such cases we only allow sufficient room to take off cap and draw shaft inboard and drop propeller off. I might add that in some cases there is no forward bearing in stern tube whatever, and more particularly that there is no brass sleeve on shafts, the steel shaft simply working on lignum vitæ bearing. This, as is well known, is a large item of expense saved, but could not be applied by us without considerable difficulty. In many cases where necessary to repair propeller shaft, it is necessary to remove thrust bearing complete. This could be avoided by using a special coupling or some other device, it being necessary then to remove only the thrust shoes and draw shaft inboard through thrust bearing. The auxiliary engines in most cases have connecting rods cast steel channel or "I" section, which makes this class of work very inexpensive.

In conclusion I would say that the one great aim seems to have been in the direction of reduced cost in every particular. Many of the above points, we must admit, would not be possible with builders of sea-going vessels. In fact, where the American Shipbuilding Company have had occasion to build sea-going vessels, such as they have recently turned out, they have found quite a difference in the cost of the two classes of work. The above article is intended to cover the work done on an average freighter and is by no means intended to cover the field that might be called special work, such as yacht and passenger work and vessels built for the revenue service, where expense is not a consideration. The latter class of work receives their very best attention.

THE ELECTRIC AUTOMATIC WHISTLE OPERATOR AND TELEGRAPH.

BY GEORGE MCQUILKIN, JR., E. E.

This apparatus is designed as an adjunct to the ordinary hand pull for opening the valve in the whistle pipe. Its functions are to place the whistle under absolute control, so that a blast can be repeated automatically at regular intervals or at the will of the operator. The flexibility of electric wiring admits of an unlimited number of operating points, which would be too complex if a mechanical means were used. From the fact that the valve responds instantly to the touch on the switch, by using a telegraph key signals may be sent by the Morse or other codes, and if the blast is not audible,

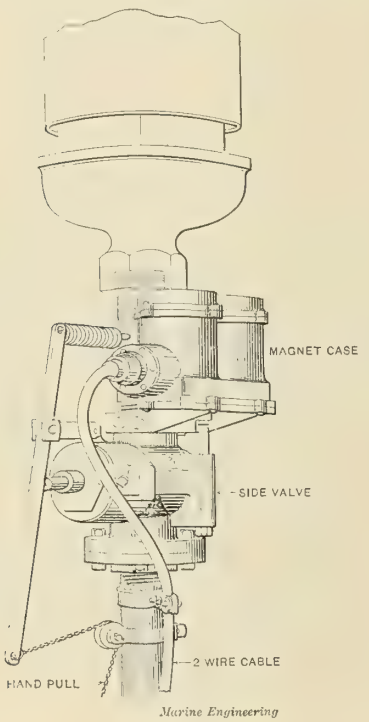


FIG. 1.

yet visible, the code may be read by the intervals between the escape of the steam.

The apparatus consists essentially of an electro-magnet carrying an armature which is normally held away from the pole pieces by a spring, but when it is desired to operate the whistle the switch is closed and the magnets are energized, attracting the armature, which in turn opens the valve in the whistle steam pipe, admitting steam to the whistle. The whistle valve and its magnet are located close to the whistle (Fig. 1), and the operating switch is generally located on the rail of the bridge.

The whistle valve is of special construction to admit of the use of the operating magnet, and is also fitted with the ordinary hand pull. This operates the main whistle valve (Fig. 4), as in ordinary construction. This main valve is normally kept closed by boiler pressure, but has a piston fitted, and when the switch is closed and the armature attracted by the magnets the stem opens the side valve and admits steam to the piston of the main valve, which is forced open and held open as long as the switch is closed and the armature keeps the side valve open. When the switch is opened the armature is returned to its normal position by springs, and the steam pressure from the boilers closes the side valve and then the main valve.

The automatic operator is generally located in the chart house, but, with a suitable water-tight case, can

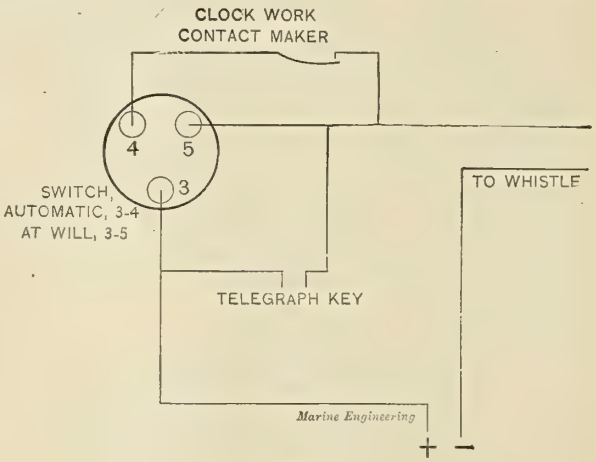


FIG. 2.

be located in exposed places. It is intended for use in navigating during stormy weather, the navigation laws requiring that a blast be sounded for six seconds duration at intervals of one minute. It consists essentially of a clockwork mechanism, carrying a contact maker that closes the circuit for the required length of

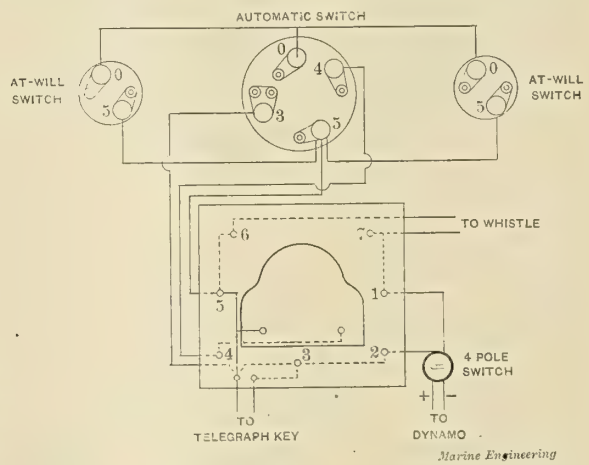


FIG. 3.

time. When it is required to operate, the switch is turned until the handle is held to the extreme left by the stop. This switches the clockwork contact maker into the circuit and operates the whistle automatically. The telegraph key is connected to the same wires that the switch is connected with, and this key being designed for rapidly making and breaking the circuit, its speed in signaling makes it superior to the switch for this purpose.

The elementary diagram of wiring is shown in Fig. 2. Starting at the positive side, it leads to the switch, and

for the "at will" operation it is closed across 3 to 5, thence to the whistle magnet, thence to the negative side. The telegraph key uses the same circuit as the "at will" operation, but does not pass through the switch. In Fig. 3 are shown the connections for two "at will" switches and one combined "at will" and automatic switch. The various binding posts on the automatic operator case are terminals for the various circuits and afford a ready means of separating the circuits for the purpose of testing.

are carried in the open it is advisable to use cable, using a twin conductor to the whistle and a triple conductor to the switch. In protected positions single wires, protected by wooden molding, may be used.

This apparatus is made for use with either battery or dynamo current, and if batteries are used they should be in groups of two or more sets, so as to avoid any liability of "running down" due to constant use. When operated by dynamo current a fuse of not over three amperes capacity should be installed in the main line.

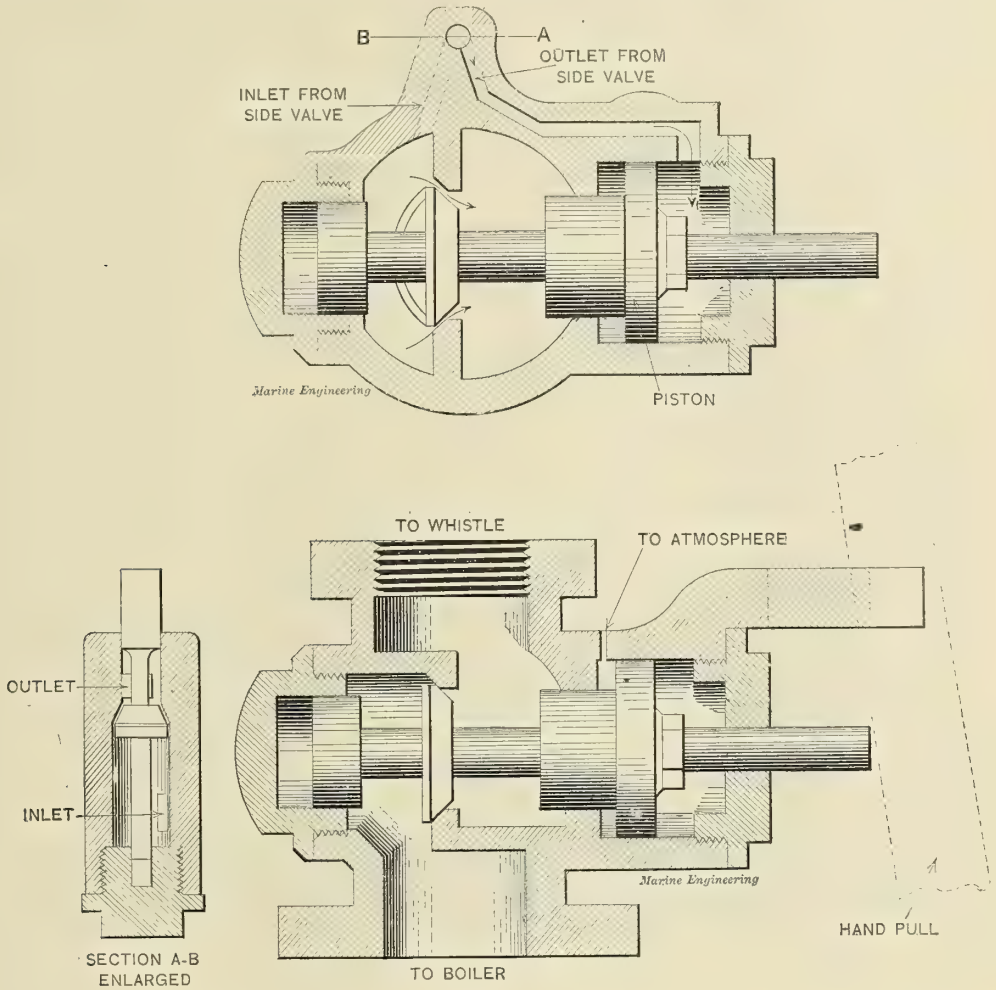


FIG. 4.

If it is desired to operate the whistle from the chart house or similar protected position, a strap key or a push button will answer instead of the water-tight switches used in the exposed positions. The only attention required is to wind the clockwork at intervals of four days, taking care not to wind too tight.

The switches should be examined occasionally, and any trace of corrosion removed, and the working parts slightly oiled with vaseline, which will tend to prevent further corrosion. In installing this apparatus, due to its exposed position, it is generally required that the wires be carried in conduits, and in this event care should be taken to provide for the expansion of the piping when fires are lighted under the boilers, and the piping up the funnel to the whistle should be fitted with a slip coupling or a goose neck bent in the pipe. If the wires

By properly proportioning the batteries and the use of a small resistance in the circuit when dynamo current is used, and using a double-throw switch, either source of power could be used. Thus if a set of batteries has 20 volts and the dynamo has 110 volts, by placing a resistance of such a value that it will dissipate 90 volts, 20 volts will remain of the 110 volts, and then when the double-throw switch is thrown in either direction the voltage would be alike. By this means a large set of batteries would be avoided and the whistle could be operated from either source.

As all the terminals are numbered, it will facilitate matters to trace the circuits thus:

1 and 2, to dynamo or battery.

3, 4, and 5, to whistle switch.

6 and 7, to whistle magnet.

An additional attachment is provided whereby the time of sounding the blast is recorded. It consists of a clockwork mechanism operating a set of dating wheels, over which are fed the printing ribbon and the paper record. The printing hammer (which strikes the record paper over the dating wheels) is operated by a lever connected to the rod of a vacuum piston. The vacuum piston is normally held up by a spring, but when a vacuum is produced on the lower side of the piston atmospheric pressure forces the piston down and operates the printing hammer. The vacuum piston cylinder is connected by an exhaust pipe to a chamber into which steam may be admitted when the whistle is blown, creating a partial vacuum around the mouth of the exhaust pipe and exhausting the air from the vacuum cylinder. A cam on the lever allows the printing hammer to return and clear the record paper, so that in case the blasts are sounded rapidly, with short intervals, there will be no aberration of the record. The printing ribbon and record paper being fed by the movement of the piston, the spacing of the record will always be in exact proportion to the interval between blasts; and the dating wheels being operated by the clockwork, there is no likelihood of confusion in reading a printed record. The recorder has attached the contact-making device similar to that above described for connection with the automatic operator, combining the two instruments in one.

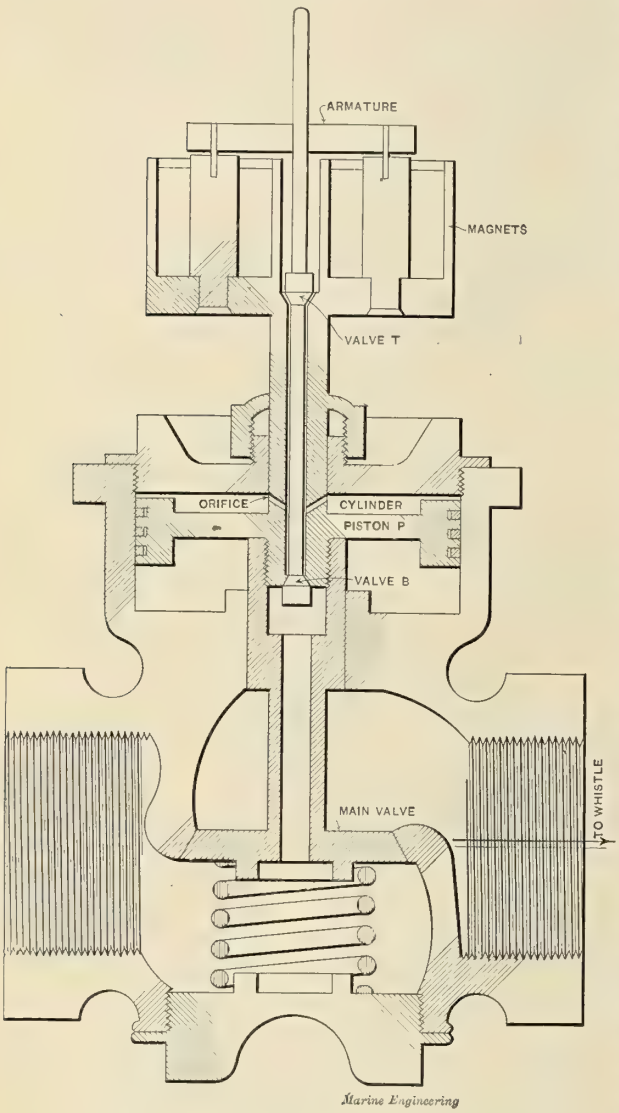


FIG. 5.

The use of the automatic operator and recorder is strongly recommended as an additional safeguard to navigation. The automatic operator eliminates any possibility of sounding incorrect signals (as is liable in case of manual operation) and spaces the interval and the length of blast accurately to a fraction of a minute. The recorder makes a record of the signals at all times, acts as a check on the log of the ship, shows accurately if the proper signals were sounded at the proper time, and thus in case of accident furnishes positive evidence regarding the point.

Another form of electrically-operated valve is shown in Fig. 5. When the operator closes the switch the magnets are energized and the armature attracted. The armature carries the valve stem and is forced downward when the magnets are attracted, closing the small valve *T* and opening the small valve *B*, admitting steam to the hollow stem of the main valve through *B* into the piston cylinder, where the steam acts to force the piston downward and thus opening the main valve and admitting steam to the whistle. Steam will flow to the whistle as long as the magnets are energized, but when the switch is opened and the armature is no longer attracted, the steam pressure on bottom of small valve *B* forces this valve closed and opens the small valve *T*, allowing the steam in the piston cylinder to escape to the air. The pressure being thus relieved from piston, the pressure acts to close main valve. The spring shown supporting the main valve acts only to support the weight of the valves and armature, so that quick action may be secured and the operation adapted to signaling.

A Floating Workshop.

The delay occasioned in ship repair in carrying the material from the vessel to the shop and return has always been recognized as a source of expense to the shipbuilder. It is, therefore, interesting to note the floating workshop which has recently been added to the plant of Messrs. Mordey and Carney, of Southampton, England. This workshop is 76 feet long, 30 feet wide, square-built of iron, and is much the same in appearance as one of our housed-in lighters in use in our harbors. The machinery includes a portable engine and boiler for driving purposes, a pneumatic compressor and receiver for operating pneumatic tools, a punching and shearing machine, drills and shapers, lathes, smiths' forges, grindstone, vise benches, tools, and stores for machinery—in fact, all that is required to facilitate the carrying out of large repairs to hulls or machinery. In addition, there is a small dynamo for supplying electric light to the shop and to that part of the vessel where the repairs are going on.

This unique shop is towed alongside of the steamer which is to be repaired, or, if the vessel is dry-docked, the shop is taken in the dry-dock, close to the ship.

Trial Trip of the Worden.

On September 11 the torpedo-boat destroyer *Worden*, built by the Maryland Steel Company, Sparrows Point, Md., underwent her official trial over the Barren Island course with most gratifying results, which are given as follows:

Run. No.	Time.	Total Rev. Star.	Total Rev. Port.	Rev. per Min. Mean.	Speed.	Steam Star. Eng.	Steam Port Eng.
1 S.	2.30 4/10	642	622	252.1	23.936	125–115	120–120
2 N.	2.34	665	650	256.2	23.376	125–120	125–120
3 S.	2.18	650	637	280.0	26.086	145–160	150–156
4 N.	2.22 8/10	672	657	279.1	25.210	150–155	150–152
5 S.	2.10 8/10	651	639	295.8	27.522	175–180	175–178
6 N.	2.14 1/10	674	664	298.5	26.765	175–180	175–177
7 S.	2.03 7/10	660	651	318.2	29.09	200–210	200–210
8 N.	2.06 7/10	684	674	321.6	28.41	210–210	205–210
9 S.	1.58	671	668	340.5	30.508	240–237	230–232
10 N.	2.03 2/10	690	689	335.8	29.22	232–230	225–225

The Influence of Shoal Water on the Speed of Vessels.

BY A. E. LÜDERS.

In the October number of MARINE ENGINEERING there appeared an article contributed by a Mr. A. D. Stevens dealing with the effect of shoal water upon the speed of ships. In his paper he set forth that the *limit* of speed attainable for a given hull, irrespective of linear dimensions, displacement, or draft, is governed entirely by the speed of the following wave—*i. e.*, "wave of translation" or "displacement"; that is to say, a vessel cannot go faster than the wave it carries behind it, and, as the speed of a wave in shallow water is given by the formula

$$V = \sqrt{gh},$$

where V = velocity of wave in feet per second,
g = acceleration due to gravity,
and h = depth of water in feet,

THE U. S. TORPEDO-BOAT DESTROYER WORDEN, MAKING 29.86 KNOTS ON TRIAL.

It will be noted from the above table that the highest speed obtained on any one run was 30.5 knots, which, with the tidal corrections, gives a true speed of 30.05 knots, and the average of the last two runs gives a mean speed of 29.86 knots. These records were obtained on the standardization trial, and on the following day the one-hour run was held and an average speed of 28.15 knots was obtained for the required time.

In all these runs the *Worden* behaved beautifully, not the slightest accident or mishap occurring to spoil the good record.

Torpedo-Boat Destroyer Goldsborough.—The torpedo-boat destroyer *Goldsborough* on September 10 again went out for Government trial trip from Seattle, and, it is reported, had reached the required speed of 28 knots and was about completing her trial, when the port engine broke down and became completely wrecked.

he argues that this value V is the maximum theoretical speed of a vessel in water corresponding to a depth h; the object of the designer being to design a hull that shall be capable of approaching this speed as nearly as possible.

There is another side to the question, and one that seems to have been overlooked—namely, the possibility of there being such a speed that the ordinary laws of resistance become more or less modified, and the probability of the character of the "wave of translation" changing so that the formula no longer holds good. The fact that Mr. Stevens was not able to record any such speed would not necessarily preclude the possibility that such a speed existed, but rather that he did not have sufficient power in his boats to prove the fallacy of his conclusions.

That a speed greater, for a given depth of water, than he mentions can be and has been obtained is shown

by the speed trials in shallow water of various Danish naval vessels. The reader is referred to the transactions of the British Society of Naval Architects, 1899, in which a paper appears by Capt. A. Rasmussen, of the Danish Navy, giving the results of the above-mentioned trials. As the article in question is not accessible to many, a few references to his work might not be out of place.

The trials were carried out by two torpedo boats, one the *Markrelen,* length 145 feet 6 inches, beam 15 feet 6 inches, draft forward 3 feet 10 inches, aft 7 feet 9 1-2 inches, and a displacement of 140 tons; the other boat, the *Söbjörnen,* was 140 feet long, 14 feet 3 inches beam, a draft aft of 7 feet 4 inches, and the displacement at that draft 127 tons; a patrol boat of about 36 tons displacement was also experimented with. The trials consisted essentially of speed trials in various depths of water, ranging from two fathoms upward. From the data obtained curves of I.H.P. and speed were plotted, and an analysis of these curves presents several interesting features.

In the first place, instead of the horse-power curve following the general parabolic form, it presented a distinct wave or inflection point at about what is considered a good speed for the size of vessel. After the inflection point was passed the slope of curve was considerably less than before that point was reached, after which the tendency of the curve was to again resume its normal character. From a curve having such characteristics we would rightly conclude that, in the case of a vessel traversing shoal water, the horse power will increase steadily as speed is increased, until a certain "critical speed" is reached. After passing that speed a comparatively small increment of power would greatly increase the speed, after which, again, increased power would only accelerate the speed at the usual rate.

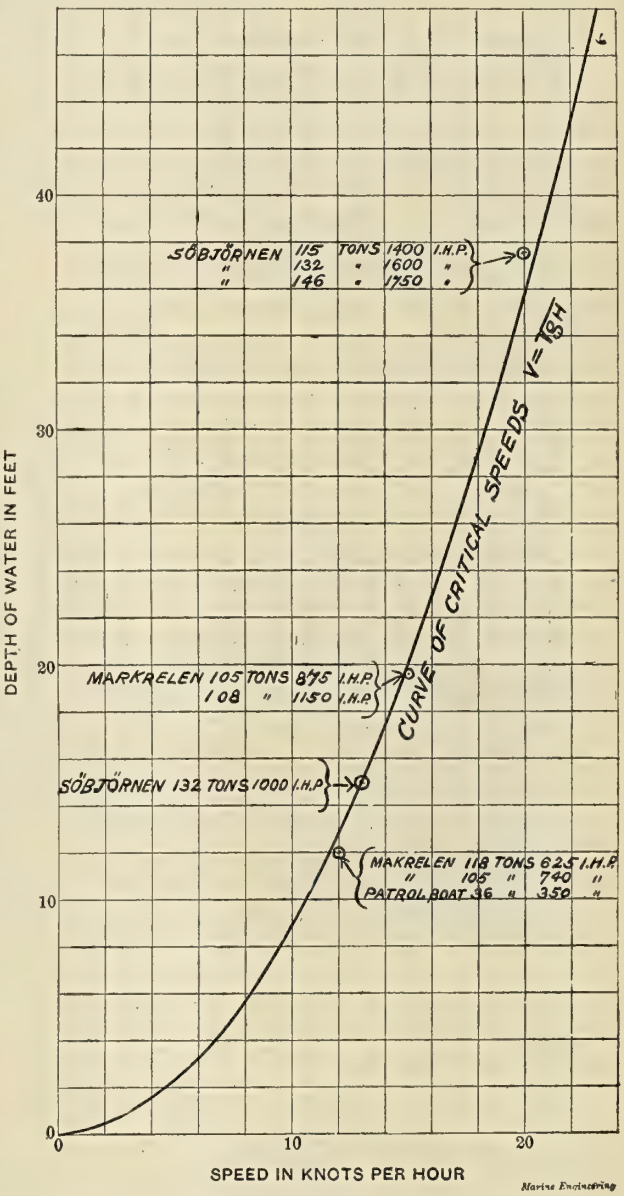
For example, take the case of the *Söbjörnen* at 132 tons displacement; in that condition the I.H.P. for a speed of 12 1-2 knots in 2 1-2 fathoms of water was 800; an increase of 200 horse power gave 13 knots, while another 200 horse power brought the speed up to 16 knots; the increase after the critical speed had been passed being 600 per cent. of that which occurred just previous to reaching that point.

That this phenomenon gradually disappears as the depth of water increases goes without saying. This critical speed is independent of size, displacement, draft, etc., of boat, it being governed entirely by the depth of water.

From the above we see that Mr. Stevens was in error by entertaining the idea of a limiting speed for a certain depth of water; in fact, a further analysis of the trials showed that it was possible to get an even greater speed in very shallow water than when the depth was very great.

The explanation of the above is that, as the speed of the ship is increased in shallow water, the boat gradually mounts on the crest of the wave of translation, and, owing to the shallowness of the water, eddies and waves that would be the result of high speed in deep water have not room to form, owing to proximity of keel to bottom of the water, and thereby a source of resistance is eliminated, and naturally a higher speed is possible.

In comparing Mr. Stevens' curve (see figure) with the critical speeds of the various boats experimented with, it will be noticed that the curve agrees almost exactly with those points. From this we see that the curve under discussion does not represent the limit of speed for a given depth of water, but does give us a "critical speed," for a certain depth of water, at which it would be manifestly uneconomical to attempt to drive a vessel.



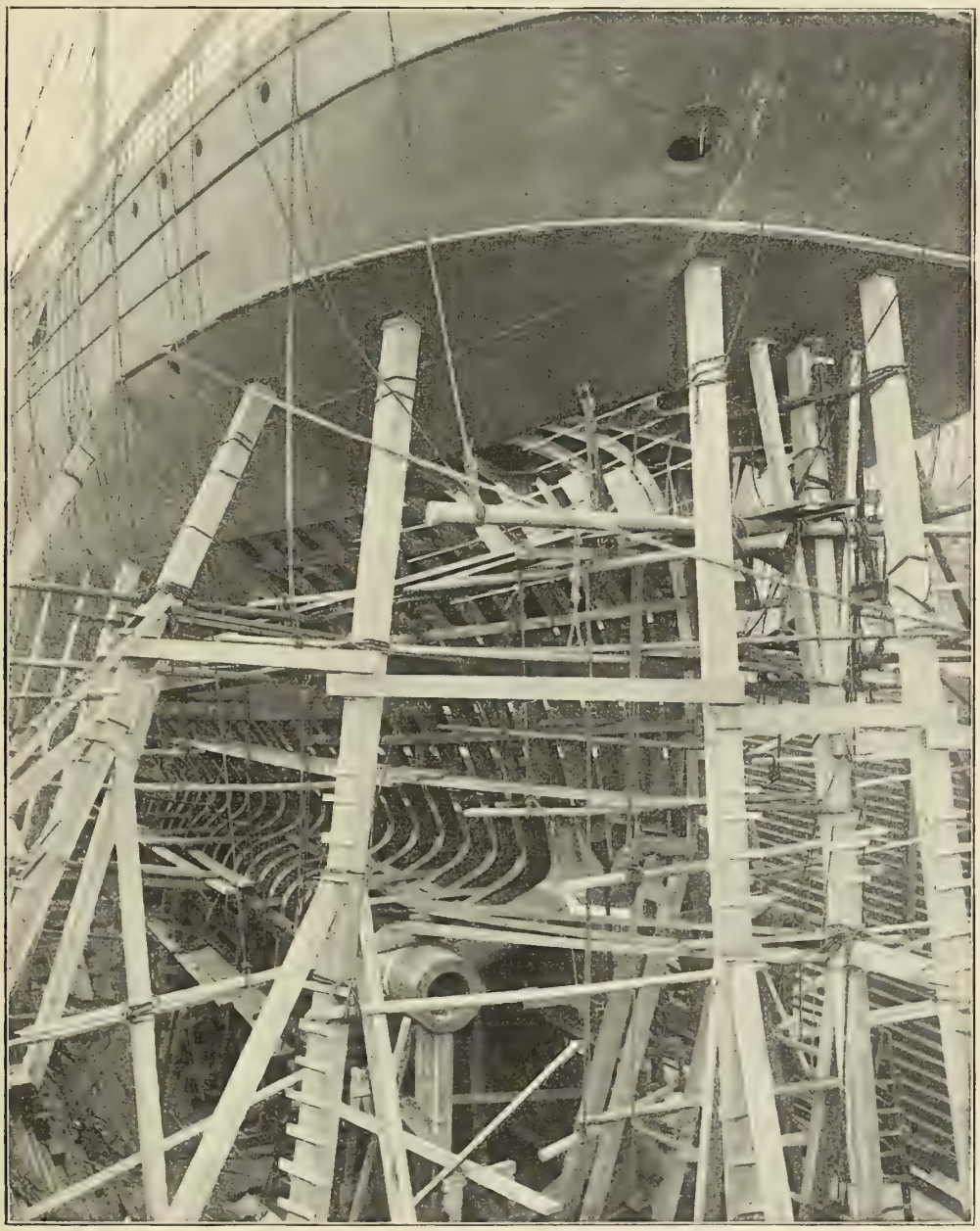
POINTS RECORDED ON THE CRITICAL SHOAL WATER SPEED CURVE.

With this curve there will be represented graphically just which speed it is advisable to avoid for a given depth of water; the manner of avoiding it—that is to say, whether the ship should be driven at a speed less than the "critical speed" or at one considerably in excess—is a point to be decided by the designer, who should be governed by the service for which the ship is destined.

Repairing the Steamship New York.

As most of the readers of Marine Engineering are aware, the steamship *New York,* of the International Navigation Company, is undergoing very extensive repairs to hull and machinery. Twelve months ago the vessel was towed from Philadelphia to the John N. Robins Company's dock at Erie Basin, South Brooklyn, and still remains on the keel blocks. The principal alteration is at the stern, where the plating, framing, and stern post were removed and replaced by spectacle framing for inclosing the two shafts within the hull plating as far out as the propeller. A stern post was fitted to take new brackets. The entire hull was gone over, and all butt straps replaced by new ones. As soon as the work on the hull is completed, the ship will return to Cramp's yard, where new engines and boilers, which are now building there, will be installed. It is doubtful whether any of the $1,250,000 estimated for the repairs of this ship will be left after this extensive remodeling and re-equipping.

Since writing the above, the work of fitting on the massive propellers of the *New York* has been completed at Erie Basin. The propellers have three bronze blades each, and the hubs are of cast steel, each blade being bolted to the hub by chain bolts with bronze ends. Around the bases of the blades are heavy circular plates of zinc to prevent corrosion. Each hub weighs about 13,500 pounds, and the three blades about 28,300 pounds. It is expected that the vessel will soon be floated from the dry-dock.



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Changes to be made in copy, or in orders for advertisements, must be in our hands not later than the 15th of the month, to insure the carrying out of such instructions in the issue of the month following.

THE question of oil fuel and its adaptation to the needs of the marine engineer is one which presents itself with increasing emphasis as time and study bring the various practical difficulties more or less satisfactorily under control, and reports from nearly all maritime nations show that the subject is attracting increasing attention, and that oil-fuel equipment is being widely installed where the special conditions favor such policy. There has been, of course, no fundamental difficulty with the use of oil fuel. Such difficulties as have arisen have been in connection with the details of the equipment, and have affected only the details of operation. Thus troubles have arisen in connection with the clogging of burners with a tenacious deposit of unburned carbon, with the formation of smoke, especially under forced conditions, with noise, with odor, with the expenditure of fresh water when steam is used as the atomizing agent, with the presence of water in the oil, putting out the flame at the burner and introducing the danger of explosions in the furnace. There has been, furthermore, great uncertainty regarding the probable cost in case the demand should be largely increased, and regarding the certainty of the supply and the readiness of obtaining such fuel except at a limited number of points of supply.

One by one these various points have been made the subject of special study, and it can fairly be said that the mechanical difficulties in connection with the combustion of the oil are well in hand, especially when the rate of combustion is moderate. Perhaps the most serious question in connection with the use of oil fuel for naval purposes is the difficulty of maintaining the highest rate of combustion, or of realizing, under hard-forced conditions, the output per pound of boiler which is possible with coal.

The recently-published volume of the Office of Naval Intelligence contains a comprehensive résumé of the progress along these lines, and we would recommend all of our readers who may be able to do so to carefully read this article. In Russia, Great Britain, Holland, Sweden, Germany, Austria, France, and Italy, outside the United States, the question of oil fuel is attracting keen interest and study, with an increasing number of installations for marine purposes. On one point the best practice seems agreed, and that is that steam cannot be afforded as a spraying agent, due to the consequent waste of fresh water. Air under high pressure, and air under low pressure, with various means for insuring the mixture of the oil spray and the air, are under experimental study and in actual use. One further point seems clear, and that is that no one system in detail is equally suitable for the combustion of the various grades of oil fuel, from the Caspian residue Astalki, through the various grades of oil found in different parts of the world. It will be very strange, however, if from the study and engineering effort now being directed along these lines there does not result information adequate for the more intelligent guidance of the engineer in his choice of methods for the use of this fuel.

THE opportunities for young men in the various fields have been more or less exploited in current literature, but there seems to be little general information concerning the openings offered in the line of practical marine engineering. The technical schools and colleges are turning out each year classes of young men who go into the shipbuilding industry; but the usual requirements of the engine room are not so much for technical

training as for practical experience, and the openings are not such as have usually attracted college graduates. The engine room of merchant and war ships must, of course, be supplied with men of skill, if machinery is to run. The designer and engine builder deliver to the owner a complicated mechanism that must be carefully operated and maintained at highest efficiency. In the big ships each and every one of the numerous auxiliaries must be watched and kept in order, and the men that fill the position of chief engineer have an amount of responsibility that deserves large compensation. As mechanical power is increasingly substituted for hand power, and the deck department of a big ship is being equipped with innumerable machines more or less intricate, the relative importance of the engineer to the captain is daily increasing.

Men to fill such positions must have ability and a long experience, which latter may only be secured by entering the profession at an early age. This is one department where the practical man reigns supreme, for no amount of theory will equip a man for operating an engine. Therefore, here is a field where the young man mechanically inclined, who cannot afford a technical education, may enter and have fair prospects of advancement and fair pay. After he has started at work his promotion will be surer if he will devote his spare hours to study, preferably under the guidance of a correspondence school.

We have received so many letters asking about this service from young men all over the country that we recently sent out inquiries to the leading steamship companies concerning the requirements for young men entering the engine-room department. On other pages of this issue will be found extracts from many of the replies received, which generally present a cheerful outlook for young men seeking such employment. By reading these letters, one is convinced that there is plenty of room for good men in this profession. In many of the companies new men are taken on as oilers, which obviates the necessity of first filling the trying positions of coal passers and firemen. This work is hard and confining, and to undertake firing a marine boiler requires a strong constitution and plenty of muscle. Then, in sea service the ship is away from the home port for days or weeks at a time, and when she returns there is always hard work ahead in overhauling and repairs, which gives an engineer but little time to himself. Notwithstanding these trying conditions, it is seldom that a man who once secures an assistant engineer's license is found to go back to a shore position.

Requirements for entering the Government service are more rigid, and the examinations cover elementary subjects and somewhat advanced engineering. There are but few positions open, but these pay well, the engineers receiving the same pay as officers of equal rank in the army.

Young men about to choose a profession and who are of a natural mechanical bent would do well to consider the openings in the practical side of marine engineering.

A RECENT announcement in the press states that in a storm on the Great Lakes two vessels foundered. This announcement is likely to awaken different sentiments in the minds of those who may read, according to their individual interests. To the owners will come reflections on the uncertainties of the shipping business, financial loss, etc., aside from the loss of human life. To other owners in competing business will come the thought that so long as no lives are lost the competition may well be spared, while to the builder will come similarly the thought that something new will be required to take the place of the old, and that, after all, it's an ill wind that blows no good. It may fairly be questioned whether, outside of those suffering direct loss, such accidents are taken as seriously as they deserve. An accident is an occurrence more or less unforeseen, or due to conditions more or less beyond direct human control. In most accidents, however, there is no fundamental necessity, and a little keener foresight or a little better provision would have served to prevent. An accident usually happens because in the struggle of opposing forces tending toward safety and destruction, the latter, due to some minor initial cause, obtain the upper hand, and destruction follows. How little, in most cases, would be required to cause the balance to incline the other way and to insure the triumph of the forces tending toward safety! The preservation of our ships and shipping is a most complex matter. It is in the hands of designers, builders, owners, Government inspectors, operators, and, lastly, the general public. Are all of these varied influences at work harmoniously and with serious effort to insure the highest safety of American shipping, with the lives and property committed to its charge? We fear that the answer at most could be only a qualified affirmative.

Troubles with and Remedies for Leaky Pipe Joints.

BY C. A. MCALLISTER, CHIEF ENGR., R.C.S.

Joints, as every marine engineer knows, are a very important thing on board ship, as well as elsewhere, but particularly so around marine work. To the engineer on watch nothing is more annoying than to have a joint blow out, especially as they almost always do so at a time when they shouldn't. Seldom does a joint give out when a vessel is tied up to the wharf and you have plenty of time to fix it up. No, they seem to wait until just as you are getting under way or ready to cast off from the wharf, and those that don't give out at that time usually wait until you get well outside and are bucking into a nasty headwind and sea. If you are bound to the southward in the winter time they will kindly postpone their "blowing" until you get well out of cool weather and down around the equator, where even a thermometer would complain of the heat. Then, too, "blowing" joints are quite particular as to their location. Most well-regulated joints would feel mortified if they should blow out in an accessible place. If there are five joints in a line of pipe, with four of them that can be easily reached, you always find that the fifth one, close up under a deck beam and back of a blower or pump, is the one that starts to sizzle and sputter in a spiteful sort of mood, as much as to say, "Get at me if you can." Then comes the weary second assistant with a coal passer to help him "get at" that sizzling joint. They stand on their heads, hang on with one hand and two fingers of the other, then try to work with the remaining three fingers, and finally ascertain that there is no wrench on the ship that will reach the two nuts at the back of the joint. Then they take an open-ended wrench and bend it until it looks like a cow's horn. After experimenting with it for another ten minutes they find that in a certain position they can get about a sixty-fourth of a turn on each nut. Finally, after numerous burns and an exhausted vocabulary of profanity, the spitting and sizzling is stopped temporarily, only to break out again at some other inopportune moment. After a few such experiences most engineers will agree that there are two principal classes of joints, viz.:

1. Joints that leak.
2. Joints that don't leak.

To get all the joints about the steam machinery into the class of those that "don't leak" is the desire of every engineer who goes to sea. To attain this delightful condition of affairs is something that is seldom accomplished, except for short periods at a time. When you consider the hundreds of joints which are necessary to connect up the various parts of the machinery of an ocean-going vessel, it is but little wonder that some of them are always leaking.

To have joints tight depends about equally upon two things, the first of which is that they must be well designed, and the second is that they must be given intelligent attention. While it is well-nigh impossible to make a poorly-designed joint tight by the most skillful attention, the opposite condition of affairs holds with about equal force.

In the design of flanges for joints great care must be exercised to see that the following conditions are fulfilled:

1. That the pipes are properly secured to the flanges.
2. That the flanges are of sufficient thickness.
3. That there are a sufficient number of bolts and that they are properly spaced.
4. That the faces of the flanges are of sufficient width.
5. That the flanges are exactly parallel and do not have to be sprung together by the bolts.

If any of these conditions are neglected, then trouble will be encountered in keeping the joint tight. The most frequent fault met with is that pipe flanges are made too thin, especially if they are of composition, where, in order to save metal, the efficiency of the joint is sometimes sacrificed.

Frequently joints are designed for high steam pressures, where the bolts are spaced so far apart that the gaskets will blow out between them. Sometimes the gaskets have to be put in so narrow that they blow out from this cause alone, although most joints are made amply wide, providing the other requisites for a good joint are carried out. There is great need of a universally-adopted standard in the matter of pipe flanges. As it is now, each shipyard has its own standard for these most important details—some good and others decidedly indifferent. The Government has a standard for pipe joints designed for different pressures, and a number of yards which do navy work have adopted this standard in order to save a complication of patterns.

Attention to small details, such as flanges, goes far toward the successful operation of marine machinery. There is but little doubt in the minds of most engineers that the superiority of the far-famed *Oregon* is to no small extent due to the careful manner in which even the most minute details were worked out. Among these, none was of more importance than the tight joints due to the careful designing and fitting of the numerous pipe flanges.

Of almost equal importance to the flanges themselves are the gaskets fitted between them. While it is true that the best joint is one where no gasket at all is used (that is, the ground or scraped joint), its great expense and the fact that it must be kept permanent precludes its use except in comparatively few cases. Gaskets, therefore, must be used, and one of the objects of every painstaking engineer is to get the best gaskets for the purposes intended. Not so very long ago there was but little choice in gasket material, as the ordinary rubber and canvas article was about all that was available. With the advent of higher steam pressures the ordinary rubber gasket was found to be unsuitable for the increased temperatures. The demand has been promptly met by a number of patented materials, several of which are most excellent. Many engineers insist that nothing is better than usudurian and wire gauze, and as a matter of fact it is hard to beat. For joints in water pipes the old-fashioned rubber and canvas material is still much used, although it does not last so long as some of the patented packings. Gaskets made of asbestos in one form or another have met with much favor, especially for high steam pressures. For cylinder and valve-chest cover joints there is probably nothing made that can equal it for durability and efficiency. The experience of many has been that where it is used for joints of pipes through which water is liable to be carried with the steam, it soon gives out. The hot water softens it and it gradually washes away.

The writer knows of one case where no less than twelve turns of 1-inch asbestos round packing were used in the slip joint on a 12-inch main steam pipe, and in less than a week's time it had to be entirely repacked. The boilers had foamed considerably and the action of the water in the steam had simply washed the asbestos out of the joint. Various combinations of rubber and soft metal have been invented, and some of them give very good satisfaction. Then, too, soft metal, such as copper, is used for gaskets, with more or less success, depending upon how carefully it is fitted. In locomotive practice a very efficient joint is made by brazing together a piece of 7-16-inch copper wire and fitting it inside of the bolts of the flange. The wire is annealed before being put in place, and is held in position by three or four spots of solder. One of the flanges is also grooved to fit over the wire. This makes an excellent joint and one that could very readily be adapted to certain parts of marine work.

For permanent joints, such as those on boiler fittings, some engineers still cling to the old-fashioned cement style, made of red and white lead and iron filings mixed up to the consistency of putty. This mixture put between two pieces of wire gauze makes a very serviceable joint, if properly mixed and applied.

If shipbuilders would furnish a set of sheet-iron templets for the various sizes of pipe flanges on board ship, many blessings would be heaped upon their heads by the poor unfortunates who have to yank the pipes apart to get the diameter of the bore of the pipe and the spacing of the bolt holes. For a few dollars' expenditure in the outfitting of a ship a complete set of these useful things could be furnished. They could be marked without much trouble and would stow away in a very little space. Another convenience to the joint-maker is a gasket cutter, a very simple contrivance, something like a beam compass, yet one which saves considerable labor and makes neater work than is accomplished with a knife. Punches for the various sizes of holes from 1-2 inch up to 1 1-2 inches come in very handy, as it takes a very skillful man to carve a hole that is exactly round with only a penknife to work with. Much trouble will be avoided if the carver-out of gaskets would leave an ear or projection on the outside to assist in adjusting them in place. The ear can very readily be cut off after the joint is set up. No gasket should ever be put in place until it has been coated on both sides with a coating of blacklead or plumbago and oil or tallow. He who neglects this important step in joint making will live to regret it if he happens to be around when that joint has to be remade. One or two experiences of scraping the remnants of a baked and hardened gasket off a flange will serve as a good aid to memory for the future.

In making joints in steam pipes they should always be "followed up," as the saying goes, after the steam has been turned on. No matter how tightly the nuts have been set up when cold, you will always find that you can get a little more on them after the pipe and flanges have been thoroughly heated. Temperature has a great deal to do with tight joints. Inexperienced people often think that joints are done for, when, as a matter of fact, the pipes have been filled up with water, which has started them leaking. A joint that will be perfectly tight under a high steam pressure will frequently leak if cold water is allowed to collect in the pipe. This is simply due to the expansion of the metal when the greater heat of the steam is applied. Draining a pipe thoroughly often saves the making of a new joint to replace one that is supposed to be worn out.

ENGINEERS' DICTIONARY.—XXXVIII.

Reversing Engine. In large marine engines the valve gear is too heavy to be controlled or reversed by hand, so that it becomes necessary to provide a separate and special engine for this purpose. This is known as the reversing engine.

Reversing Gear. A general term referring to the entire mechanism employed for reversing or controlling the valve gear.

Reversing Lever. A lever operated by hand and connected with the valve for operating the reversing engine. By means of a lever the reversing-engine valve is under control of the operator, and through this the reversing engine itself, and hence the main valve gear, and through this the main engine.

Reversing Shaft. A shaft usually carried either on the front or back of the columns near the top and to which are secured arms connected by rods to the main engine links. The reversing-engine piston rod is also connected through a suitable connecting rod to another arm of the same shaft. By this means the motion of the reversing-engine piston is transformed into a partial rotation of the reverse shaft, and through the reverse arms this is transformed into the required movement of the main engine links. The reversing shaft is also quite commonly known as the *weigh* shaft.

Reversing Propeller. A form of propeller usually having but two blades, each of which is mounted on a pivot or in a socket in such a manner that it may be rotated about an axis along its length to a sufficient extent to change the general direction of its obliquity from right hand to left hand. In this manner, with the shaft turning constantly in one direction, the propeller may be transformed from go ahead to back, or vice versa. It must be understood that a propeller of the usual form, right-hand for example, cannot be transformed by any such twist of the blades into a true left-hand propeller. Furthermore, the blade necessary for satisfactory operation with a reversing propeller must be a mean between the two forms required for right- and left-hand propellers. For this reason it is unable to operate with the highest efficiency in either position, and such propellers can hardly be considered advisable when considerations of the highest efficiency are of importance. They are, however, of great convenience in connection with many modern forms of gasoline engines in which the shaft is allowed to rotate continuously in one direction while the reverse is effected by shifting the blades in manner indicated. For an intermediate position the plane of the blades will lie nearly transverse, and in consequence the boat will be urged neither ahead nor back.

Rock Shaft. A name sometimes given to the reverse shaft.

Red-Lead Joint. A joint or connection between two surfaces made tight by the use of a putty composed

of red lead and oil. Such joints, if allowed to harden somewhat before being subjected to the influence of steam or pressure, remain tight for indefinite periods of time. The proper making of a red-lead joint requires care in mixing the putty and in the arrangements for securing it between the surfaces of the joint. Red lead with oil in one form or another forms one of the standard materials for the making of joints.

Rotary Engine. An engine in which the moving parts have a motion of rotation only. Thus the steam turbine is a form of rotary engine. Rotary engines have been designed in a great variety of forms. In the turbine the steam is utilized in the form of a jet or vein rushing with great velocity along the curved side of a series of blades carried on a revolving runner. In this way the steam is used in a manner similar to water in the turbine water wheel. In other types of rotary engine the steam acts more directly by pressure and expansion, as in the common steam engine. But little success has been attained in the development of rotary engines of the latter type. The turbine has, however, been developed to a high degree of engineering efficiency, and it has already established itself in the field of marine propulsion.

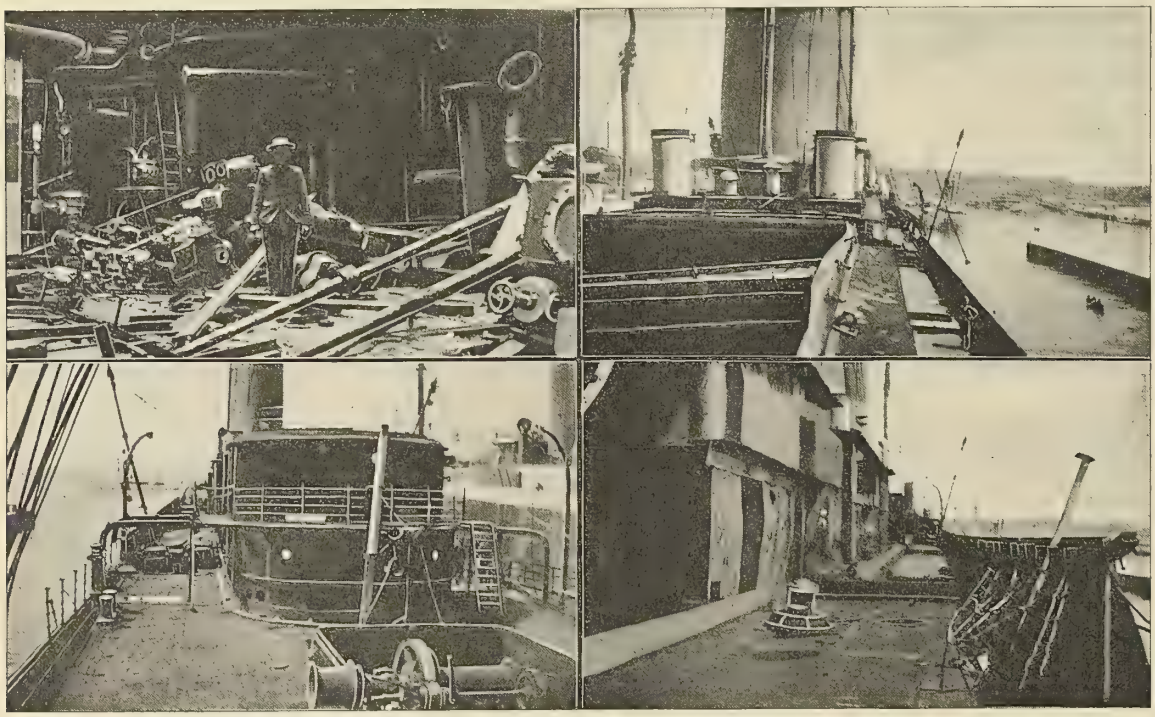
Rust Joint. A joint made between two surfaces by the use of a mixture of iron filings and sal-ammoniac moistened with water. This gives rise to a series of chemical actions resulting in the rusting of the iron, accompanied by an expansion in bulk and the formation of a hard compact cement. Rust joints can only be recommended for emergency repairs or for locations where there is no occasion to take the joint apart, as it is with difficulty that the surface of the flanges may be cleaned at a later day.

The Burned Saale.

The reconstructed *Saale* was described in August last, and since then a contributor has forwarded the following snap-shots, taken after the *Saale* was moored at the Townsend-Downey Shipbuilding Company, following a short time after the fire.

The views speak for themselves the damage which this ship sustained, both to hull and machinery. The plates of the deck and deck houses were badly warped and bent by the intense heat, and the engines were a complete wreck.

The view in the engine room shows to what an extent the machinery was damaged; the main engines fell down and the auxiliaries on top of them, leaving nothing but a mass of scrap. The lower left-hand view is of the deck, taken after the ship was rebuilt.



VIEWS OF THE BURNED AND RECONSTRUCTED SAALE.

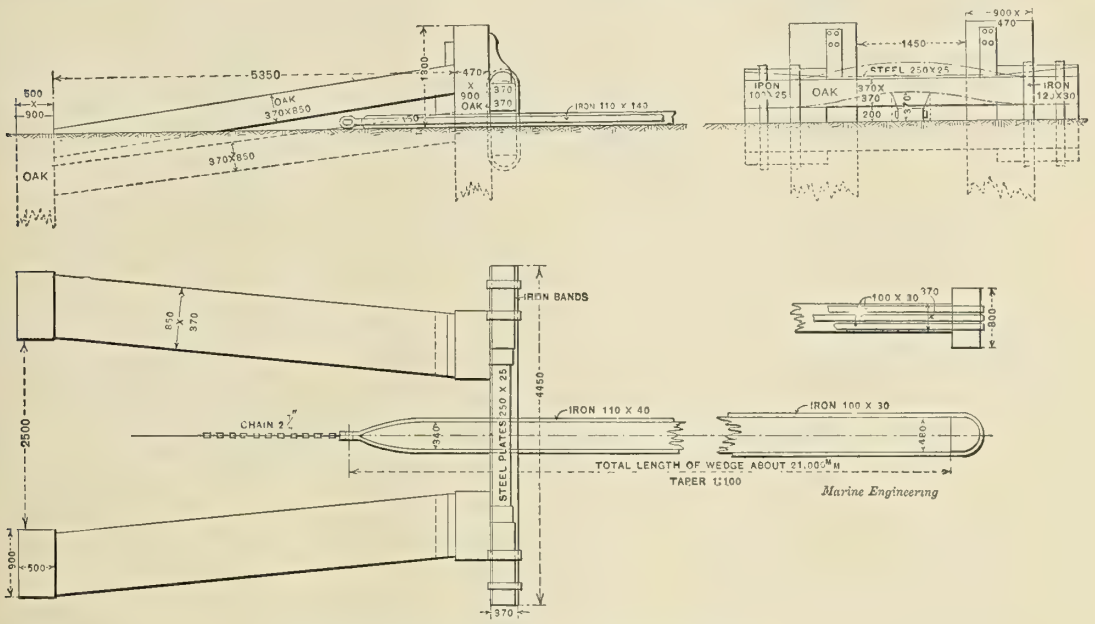
The third view was taken on the upper deck looking aft, and shows the twisted hatch coamings. The lower right-hand view was taken from the promenade deck looking aft, and here the warped deckhouses and bulwarks, stanchions, etc., are clearly shown.

Fuel-Oil Steamer.—The former transport *Rosecrans*, recently purchased by the Matson Navigation Company, is now undergoing alterations at San Francisco for use in the oil trade between the coast and Hawaii.

Annual Report of General Dumont.—The annual report of General James A. Dumont, Supervising Inspector General of the Steamboat Inspection Service, shows that the number of lives lost on steam vessels from various causes during the year ending June 30, 1902, was 445, an increase of 110 over the previous year. The total number of steam and motor vessels inspected during the year was 8,761, and the sailing vessels and barges inspected numbered 500.

Launch of the Kaiser Wilhelm II.

In launching the mammoth North German Lloyd steamer *Kaiser Wilhelm II.* the builders, the Vulcan Company, of Stettin, Germany, not only had a problem to successfully carry the vessel into the water, but also to stop her after she was water-borne. To bring the ship to rest two anchors were thrown overboard as soon as the vessel floated. On the starboard side there was bolted near the stern a large forging with eye-bolts for securing several chain cables. One of these cables was connected to a series of large wooden disks which floated vertically in the water, one disk after the other being brought into play as the cable became taut. The final stopping, however, was provided by friction brakes in the form of long wedges. These are not new to German practice, but are unusual elsewhere, and are much to be preferred to heavy weights, which are frequently used and drawn down over the ground of the shipyard.



BRAKES USED FOR SNUBBING THE KAISER WILHELM II.

The brake is simple and consists of a wedge-shaped log of oak, bound at the sides with steel plating, and having at the end an eye-piece to which is secured the ship's cable. These brakes are drawn through oak framing consisting of two horizontal beams firmly secured by wedging steel bands between vertical piles and stayed by heavy shoring.

As a result of bringing these successive systems into operation, the ship was gradually stopped without straining. For the above facts and illustrations we are indebted to the London *Engineer*. Dimensions are given in millimeters.

Atlantic Steamship Combination.

The International Mercantile Marine Company is the name of the great Morgan shipping combine which has taken over the properties of the American, Red Star, Atlantic Transport, White Star, Dominion, Leyland, and Holland-American lines of steamers, and also the great shipbuilding plant of Harland and Wolff, Belfast, Ireland. The new company is an enlargement of the International Navigation Company, a New Jersey corporation, which operates the American and Red Star lines. The capital of the International Mercantile Marine Company is $60,000,000 preferred stock and $60,000,000 common; an issue of $75,000,000 4 1-2 per cent. debenture bonds is also provided for. The new company will have the following-named officers and directors:

President—Clement A. Griscom.

Vice-President—Right Hon. W. J. Pirrie.

Directors—C. A. Griscom, P. A. B. Widener, B. N. Baker, John I. Waterbury, George W. Perkins, E. J. Berwind, James H. Hyde, Charles Steele, Right Hon. W. J. Pirrie, J. Bruce Ismay, Sir Clinton E. Dawkins, Henry Wilding, Charles F. Torrey.

Executive and Finance Committee—C. A. Griscom, P. A. B. Widener, George W. Perkins, Edward J. Berwind, Charles Steele.

British Committee—Sir Clinton E. Dawkins, chairman; the Right Hon. W. J. Pirrie, J. Bruce Ismay, Henry Wilding, Charles F. Torrey.

The majority of the Board of Directors is composed of Americans, so that the control is vested on this side. In regard to its relation to the British Navy, it is announced that the British companies will retain the subventions they are now enjoying; the combine is to receive equal treatment with lines not included by it in the matter of mails and other contracts, and in case of war Great Britain may purchase or charter any of the combine's ships flying the British flag.

Through subsidy arrangements control of the North German Lloyd and Hamburg-American steamship companies is virtually vested in the International Mercantile Marine Company, which thus embraces all of the large lines excepting the Cunard Line. According to the new schedule there will be a mail steamer arriving at and departing from New York every day in the year, and there will be a bi-weekly passenger and freight service from each of the ports of Baltimore and Boston

THE LAKE ERIE STEAMBOAT WESTERN STATES.

The Eastern and Western States.

The accompanying illustration of the *Western States* was taken of this new steamer while on her regular service between Detroit and Buffalo. This steamer, with her sister ship, the *Eastern States,* was turned out the beginning of the summer from the Detroit Shipbuilding Company. The distance between the cities of Buffalo and Detroit is 260 miles, of which about 60 miles is shoal water, necessitating slow speed. The remainder of the trip, however, is run at full speed, or about 20 miles per hour. Nightly service between the two cities is maintained by these two vessels.

The ships are identical in every particular, the general dimensions being as follows:

Length over all	366 ft. 0 in.
Length of keel	351 " 0 "
Beam	45 " 0 "
Beam over guards	80 " 0 "
Depth	19 " 6 "
Draft	12 " 0 "

The general style of the interior arrangement is similar to the latest Long Island Sound steamers, and the cabins are very handsomely finished. There are two complete passenger decks, with the quarter deck and cabin aft. Freight and express packages are carried on the main deck forward.

As will be noted in the picture, the ship is propelled by paddle wheels of small diameter. The principal dimensions of the engine, which is an inclined compound, are: 52 inches diameter of high-pressure cylinder, 72 inches diameter of low-pressure, each working on a separate crank with a common stroke of 84 inches. The wheels have feathering buckets 4 feet wide by 13 feet long and are 25 feet in diameter. The main shaft is supported by 6 journals. The crank shaft is 18 1-2 inches in diameter and the wheel shafting 20 1-4 inches. There are six single-end Scotch boilers, 13 feet long and 13 feet 6 inches diameter, with a total grate surface of 275 square feet. The Howden system of forced draft is used.

These vessels were designed by Mr. Frank E. Kirby, who is at present preparing designs for two passenger and freight vessels similar to, but larger than, the above.

Navy Estimates for 1904.

In the Navy estimates for the year 1904, recently made public by the Secretary of the Navy, the total amount to be asked for is $82,426,030.58, of which $28,024,872 is for the expense of new construction, distributed as follows:

Construction and machinery	$15,025,632
Armor and armament	10,000,000
Equipment	400,000
Two steel training ships, sail	750,000
One wooden brig, training vessel	50,000
Miscellaneous—	
Buildings at Naval Academy	1,250,000
Construction work, Washington Navy Yard	498,740
Improvements, Indian Head proving ground	50,500
Total	$28,024,872

This does not include the sum of $21,386,533, which is the estimate for the Bureaus of Yards and Docks, Equipment, Construction and Repair, and Steam Engineering.

Monthly Shipbuilding Returns.—The Bureau of Navigation reports 123 vessels of 43,743 gross tons built in the United States and officially numbered during the month of September, 1902. The largest steel steam vessels included in these figures are: *Finland,* 12,760 gross tons; *Texan,* 8,633 gross tons; *Frank H. Goodyear,* 4,815 gross tons.

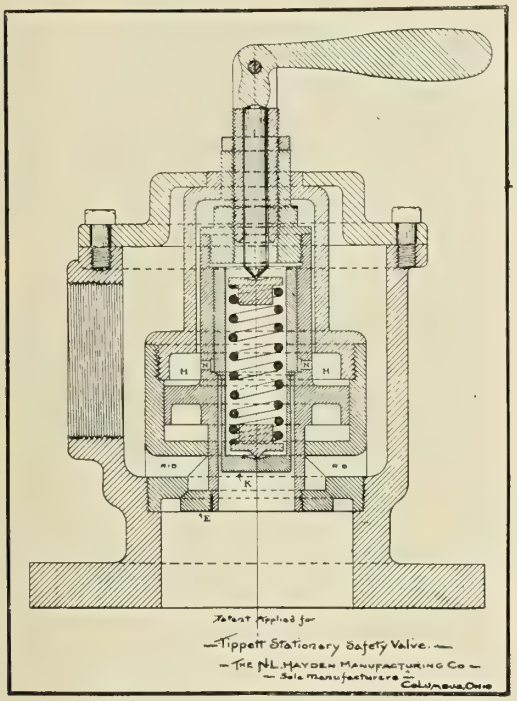
Oil Tanks.—Because of numerous complaints of weak fuel tanks on board steam vessels about San Francisco harbor, the local inspectors have issued a circular stating that fuel oil tanks for marine purposes must be made of 1-4-inch material for vessels navigating inland waters, and 5-16-inch for sea-going vessels. Rivet holes shall be drilled and all seams double riveted.

Electric Power in English Shipyards.—The city of Sunderland, which is the headquarters for one of the largest shipbuilding districts in Great Britain, has decided to build a large electric-power plant for furnishing electricity to shipyards of that locality. Current is to be generated at 550 volts and supplied at low pressure to the works from sub-stations. The cost of the undertaking will be in the neighborhood of $300,000.

ENGINEERING SPECIALTIES.

A Compact Safety Valve.

Safety valves are generally made to depend upon the tension of a heavy spring for operating, and the amount of the opening of the valve is generally limited by this spring tension. The accompanying illustration shows a valve which is built on a different principle in that the main valve is operated by a small secondary valve which is controlled by a light spring. The valve opens with promptness and without any increased resistance. Referring to the sectional cut here given: Steam rises against the lower end of the adjusting valve, *K*, which is held to its seat by the tension of spring *M*, which is set to the required pressure; when this pressure is reached, adjusting valve *K* opens and allows the steam to escape through the ports *N*, *N* into the chamber *H*, against the top of the main valve,



A COMPACT SAFETY VALVE.

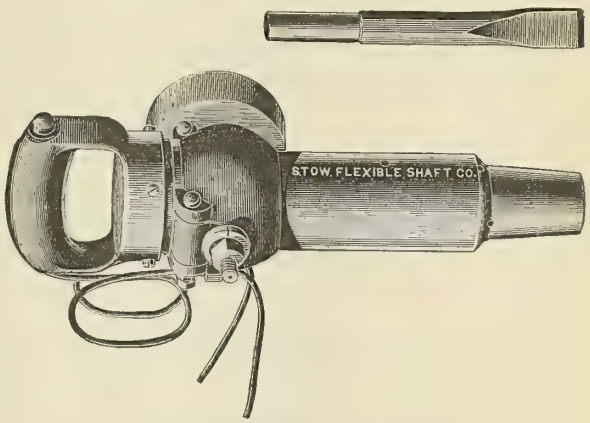
E. This downward pressure opens the main valve and the boiler is relieved. When the boiler pressure decreases to such an extent that spring *M* closes adjusting valve *K*, then the steam coming through the ports *N*, *N* is shut off, and the main valve, *E*, closes.

Any desired amount of opening of the main valve is obtained, which prevents any increase of pressure over the popping point. Thus, it will be seen, the operation of the main valve is positive, the force holding it to its seat increasing as the pressure rises, until the release point is reached. The pressure can be released without reseating the valve for the purpose of blowing off or for making repairs, washing out, etc., by relieving the light tension of the small spring, which is adjusted by the handle at the top. This valve, called the Tippett Safety Valve, is made by the N. L. Hayden Manufacturing Company, 108 West Spring street, Columbus, O.

Portable Electric Hammer.

The electric hammer which is here illustrated is making a good record for itself as a labor saver. It is stated that it is fitted for all classes of work now done by pneumatic hammers, such as chipping iron or steel in foundry work, bridge building, calking of boilers, structural iron, shipbuilding, etc.

The main points claimed for this portable electric hammer are the simplicity of construction; efficiency and durability; no plant is required, as the current may be taken from any electric power from 110 to 500 volts; economical operation; transportation of power a great distance with practically no loss.



PORTABLE ELECTRICALLY-DRIVEN HAMMER.

Another advantage is that the electric hammer may be used in the coldest weather, as, of course, there is no danger of its freezing when out of doors as sometimes occurs with the pneumatic tools.

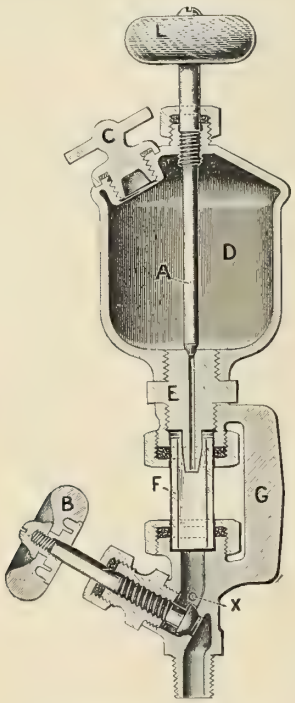
There are three sizes of hammers: No. 1, for stone carving; No. 2, for medium chipping, calking, and light riveting; and No. 3, for heavy chipping and riveting. When no current is obtainable a small 1 horse-power electric generator, capable of running three hammers, may be installed at small expense. Inquiries concerning this hammer, which is called the Jackson portable electric hammer, should be addressed to the Stow Flexible Shaft Company, Twenty-sixth and Callowhill streets, Philadelphia.

Automatic Sight-Feed Graphite Lubricator.

With the use of high steam pressures and superheated steam, oil as a lubricator is not entirely satisfactory. Powdered graphite has long been known as a superior lubricant, having the peculiar quality of working itself into the superficies of the cylinders and valves of steam pumps and engines, giving them a highly finished surface, thus reducing the friction and requiring very little oil. While graphite possesses high lubricating qualities, at the same time it is not advisable to use it alone, and good practice recommends an oil pump, or sight-feed lubrication, in addition to the graphite. When this combination is effected, it is only necessary to feed about one-third as much oil as when no graphite is used. Another valuable feature of graphite is that it fills up the crevices and interstices of the packings; thus the stuffing boxes need not be kept so tight and the

friction on the rods and valve stems is lessened. It also increases considerably the durability of the packings. While many engineers would use graphite they have found considerable difficulty in procuring suitable apparatus for feeding it to the parts to be lubricated.

The accompanying illustration is the single-connection, graphite, sight-feed lubricator which has recently been put on the market by the Lunkenheimer Company, Cincinnati, Ohio, and which is claimed to be suitable in every way for the purpose its name implies. The graphite is fed automatically and continuously in the desired quantities and is visible by passing through a sight feed. The cup requires but one connection to the cylinder and is very simple in construction.



A GRAPHITE LUBRICATOR.

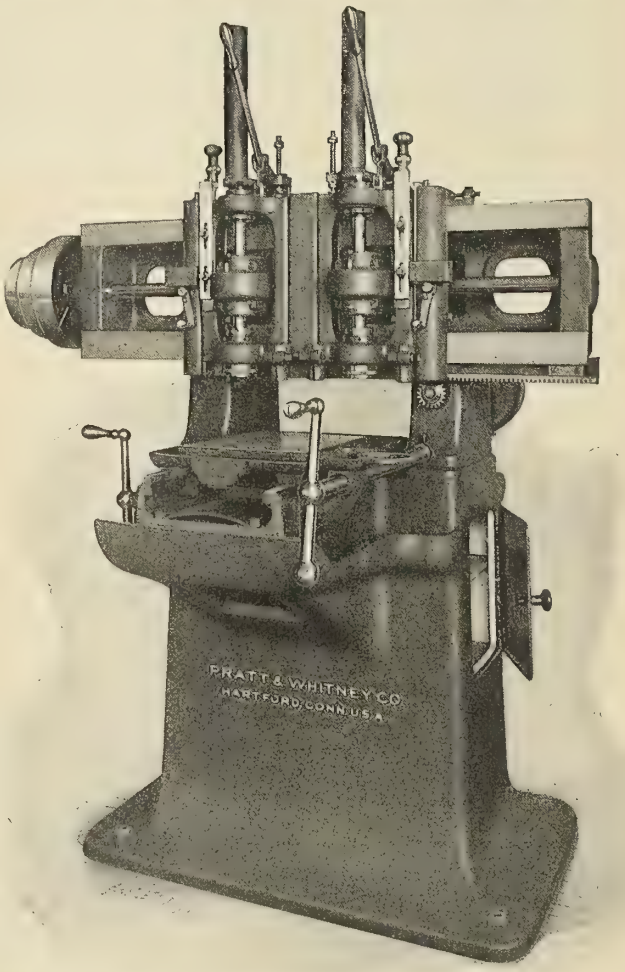
To operate the lubricator, the following points should be observed: Close steam valve *B* and open drain plug *X* to allow steam to escape from cup; then close regulating valve *A*, remove filling plug *C*, and fill cup with graphite. After replacing filling cup *C*, close drain plug *X*, open steam valve *B* (wide) and regulate feed of graphite by regulating valve *A*. The sight-feed glass can easily be cleaned by opening drain plug *X*. If necessary to replace the sight-feed glass take cup apart at *E* by means of wrench furnished, and slide the new glass down through the opening.

New Profiling Machine.

A profiling machine of entirely new design has been brought out by the Pratt and Whitney Company, Hartford, Conn. The principal feature of the machine is that it has two spindles by means of which a roughing and finishing milling cut may be taken in one setting of the piece.

The accompanying half-tone illustration gives an excellent idea of the appearance of the machine.

The column is heavy and provides a rigid support for the working parts above and contains two tool cabinets and a tank for oil or soda water. The table is held down to the bed by two straps, is guided by a single V of ample dimensions and rests upon a flat track to the right. Each spindle is driven by means of a line-contact spiral gear and pinion with liberal tooth contact and ample wearing surfaces. The gear is made from a steel casting and the pinion of phosphor bronze. They are enclosed in a tightly-fitted casing filled with a suitable lubricant. Both gear and pinion have their hubs journaled in bearings independent of the driving shaft and



A NEW TWO-SPINDLE PROFILING MACHINE.

spindle bearings, leaving the spindles free and sensitive, and permitting close adjustment with respect to tooth contact. The gear is driven by two long keys located in the driving shaft opposite each other. The driving cone pulley is counterbalanced and is journaled on the outside of the driving shaft bracket, leaving the shaft free from all strain due to the belt pull.

Ball thrust bearings are provided at each end of both the gear and pinion, permitting the spindle to be rotated with equally good results in either direction and producing a very free-running and durable drive.

The spindles are made of steel, are ground, and run in bronze bearings. The lower bearings are solid and conical in form, while the upper bearings are of cylin-

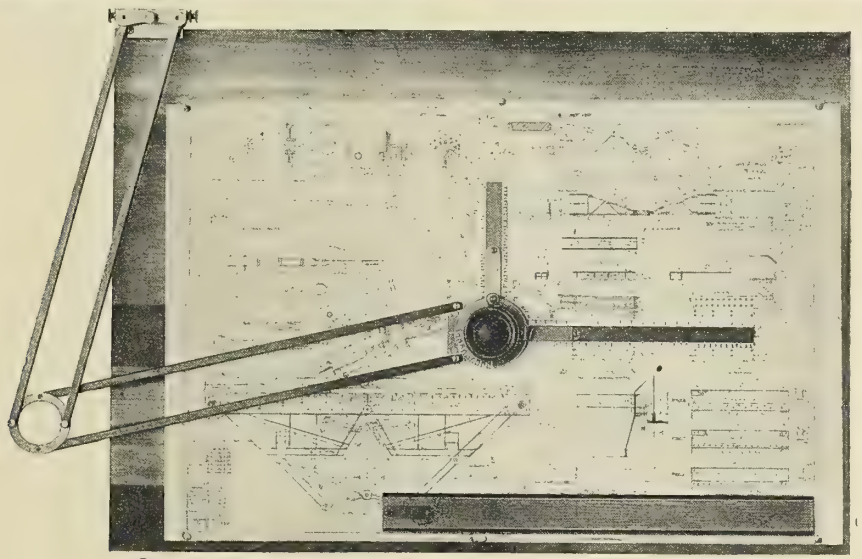
drical form and are split. Both are provided with suitable adjustment for wear. The end thrust at the lower bearing is taken by a babbitt-metal washer. If desired, the spindles may be run at 1,200 revolutions per minute.

The spindles are regularly fitted with Jarno taper, but special tapers may be furnished to order.

When not in use, each head is held in a raised position by a heavy enclosed spiral spring, yet may be readily lowered by a hand lever and clamped in any desired position. A lock bolt engaging a slot in the adjustable bar is provided for properly locating the head, and a screw with micrometer dial facilitates the close adjustment of the bar. The position of the head may also be determined by the adjustable stop located at the top.

The gearing for operating table and crosshead is so constructed as to permit all back-lash being taken up by means of double gears and double racks, so arranged that one part may be adjusted in relation to the other part, so that the teeth of each part do not exactly line up, but do fill the space of its mating rack or gear. When properly adjusted the two parts of the member may be firmly clamped together by conical studs.

The right-hand spindle head is provided with an extra former pinhole located on the opposite side of the spindle from that in which the pin regularly fits. The centers of the two holes are located equidistant from the center of spindle and in the same plane with it. In order to produce a profiling former plate directly from a model piece of work, the latter may be fastened to the table in position where the work regularly rests, and the blank former plate fastened to the position in which the finished former is afterward to be used. With the former pin in the extra hole the blank may be profiled.



A NEW DRAFTING MACHINE.

Universal Drafting Machine.

The machine here illustrated is a decided innovation for use in a drafting room, and, as a substitute for the T square and triangles, goes a long way in saving time. As drawings are now made, a line is drawn with one edge, and this edge has to be removed and another taken up in order to scale off the proper distance. This changing from one edge to another is certainly not direct, and where it occurs so many times during the day involves the loss of much time.

The Universal Drafting Machine, here illustrated, can be used for drawing parallel lines at any angle on the paper, and lines perpendicular to them, and for measuring the line as it is drawn. The little machine consists of a graduated square having an accurate parallel motion about the drawing board. The square is adopted because the work of most drawings consists of sets of lines at right angles. Both blades of the square are graduated for measuring the lines as they are drawn and are interchangeable for those of any length or any scale, and when inking is to be done a straight-edge is supplied. The parallel motion is obtained by means of two pivoted parallelograms, which constitute an arm joining the square to the board. This arm is flexible, so that the blades may lie flat upon the drawings; and it is also hinged at the connection to the board, so that it may be lifted out of the way of the paper. It may be readily changed from one board to another. A conical adjustment is provided to take up any lost motion.

Placed upon the ring is a conveniently-adjusted protractor, which allows the square to be quickly set at any angle. Thus angular work is made as rapid, easy, and accurate as straight work. Spring stops at 30, 45, and 60 degrees are provided, allowing the square to be instantly set at these frequent angles.

Summing up the advantages of this machine, they are, that the lines are drawn and scaled with the same edge and at the same time, and angular work is as easy as straight work. The machine is being manufactured and sold by the Universal Drafting Machine Company, Blackstone Building, Cleveland, O.

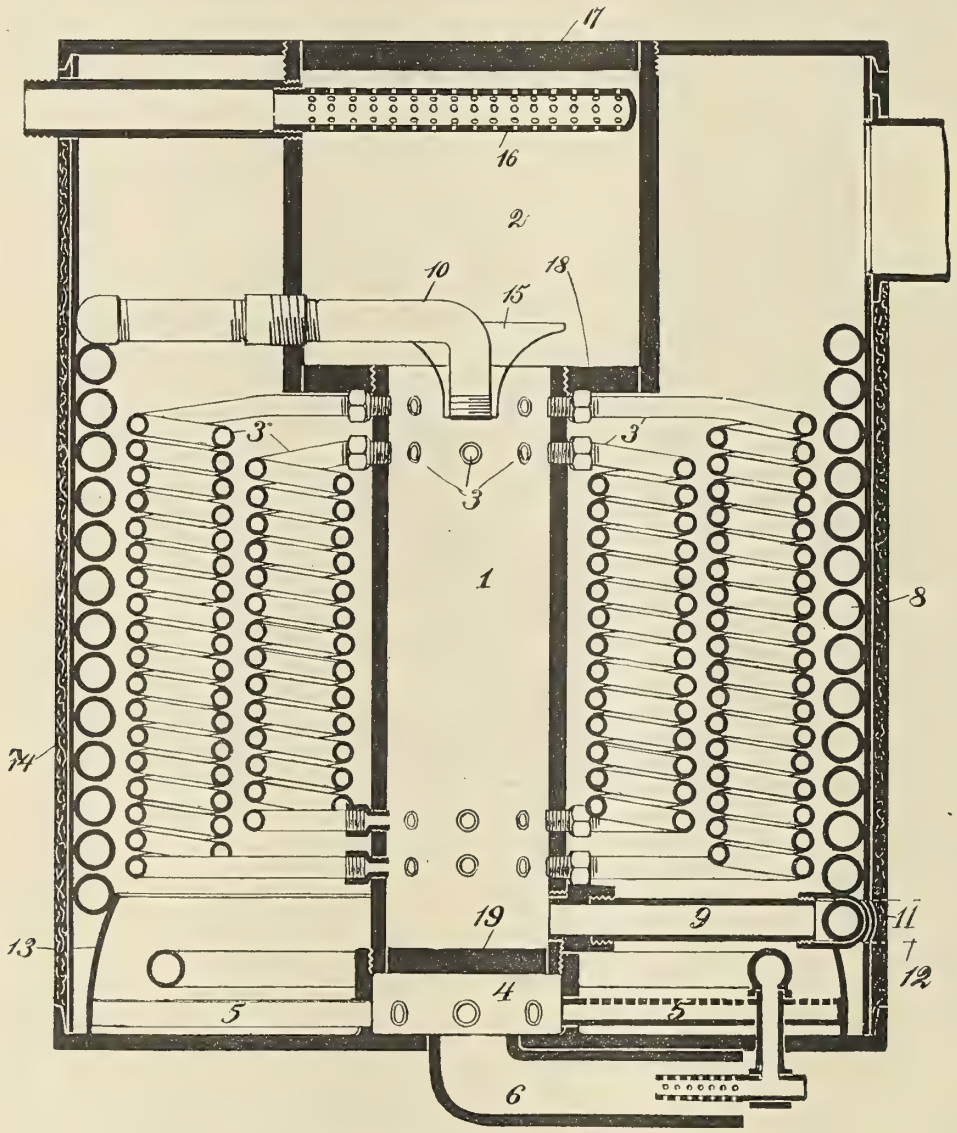
The Salamandrine Boiler.

A boiler which has sustained very many severe tests, and which it is claimed will not explode and will not be burned out, has been placed on the market by the Salamandrine Boiler Company, 220 Broadway, New York.

The boiler is adapted for launches and automobiles and can sustain high pressures.

The novel feature consists primarily in surrounding the main water and steam-containing and steam-generating portions of the boiler by a closely-coiled water tube of 7-8 inch diameter, so connected with the other parts of the boiler as to form a portion of the circulation system and to act as a wall to confine the heat from the burner, so that it will circulate most effectively against a double series of enclosed smaller coils of generating pipe and reduce the radiation of heat from the outer shell of the boiler. To further aid this purpose, the feed water is admitted first into this outer coil and caused to circulate in such a way that this tube is constantly the coldest part of the boiler. Another object accomplished at the same time is the gradual heating of the water in this tube before it enters the central and more highly-heated parts of the boiler, thus avoiding the injurious effects of cold water in a boiler.

The boiler comprises a central water chamber or column 1, a superposed steam dome 2, a double or triple series of helically-coiled generating pipes 3, connected at their upper and lower ends with the water column and arranged at a slight angle from the perpendicular, the surrounding coil of larger pipe 8, a baffle plate 15, a separator 16, a series of radial gas tubes 5, constituting a burner, a curved collar or guard 13 to direct the combustion within the outer coil of pipe, and a boiler shell enclosing the entire construction.



SECTION OF THE SALAMANDRINE BOILER.

The end of the upper pipe 10 projects into the top of the water column and is bent downwardly, so that the water from it pours downwardly and away from the dry steam pipe 16. The water column is closed at the bottom by a plate 19 of steel welded in, and at its upper end is screwed into a similar plate 18, welded into the lower end of the steam dome, the top of which is entirely closed by a welded-in plate 17. The feed-water pipe 12 is connected at 11 with the enclosing coil pipe by means of a T connection in such a way that the entering current of cold water will be in axial alignment with

the end of the coiled pipe and at right angles to the radial pipe 9 that connects with the bottom of the water column. Thus the force of the water from the feed pipe assists in the circulation from bottom to top of the pipe coil that is set up by the heat, and at the same time draws into the coil with it hot water from the bottom of the water column, thus partially heating itself.

At 4 is a distributer for the gas, from which it passes through a system of radial tubes closed at their outer ends and perforated on their upper sides to form a burner. The gas enters this distributer from the pipe or mixing tube 6 beneath, into the end of which projects the nozzle from the vaporizer. This nozzle is connected with the end of a vaporizing tube that passes around three-quarters of the arc of a circle just above the burner and then is downwardly turned through the bottom of the boiler to connect with the fuel supply.

The base of the boiler is made integral with the metal flange of the distributing chamber for the gas and with the mixing tube. These may be removed by simply unscrewing the flange from the bottom of the water column. The encircling pipe coil can also be removed by unscrewing one pipe connection at the lower end and another at the upper end, thereby rendering it a simple matter to get at the interior to remove and replace any of the inner coils if necessary.

The inner generating coils are arranged at a slight angle from the vertical to more effectively utilize the ascending heat. As the burner is composed of a number of separate short tubes, it is a very simple matter to replace any of them that may become defective.

Meeting of the Society of Naval Architects and Marine Engineers.

The tenth annual meeting of the Society of Naval Architects and Marine Engineers will be held at 12 West Thirty-first street, New York city, on November 20 and 21, on which dates the following technical papers will be read:

THURSDAY, NOVEMBER 20.

1. "Technical Training for Shipbuilders." By Henry S. Pritchett, LL.D.
2. "Progressive Trials of the Screw Ferryboat *Edgewater*." By Edwin A. Stevens, Vice-President, and Charles P. Paulding, Junior.
3. "Why It Takes So Long to Build and Equip a Naval Vessel for the United States." By George W. Dickie, Member of Council.
4. "The Preliminary Official Trial of the U. S. Battleship *Maine*." By Assistant Naval Constructor J. W. Powell, U. S. N., Associate.
5. "The Water-tube Boiler in the American Mercantile Marine." By Wm. A. Fairburn, Member.
6. "Longitudinal Bending Stress on Damaged Ships." By George C. Cook, Member.
7. "Some Problems on the Surfaces of Buoyancy and of Waterlines." By Professor Cecil H. Peabody, Member of Council.
8. "Experiments and Formulæ on the Strength of Ships' Beams." By K. G. Meldahl, Naval Architect, Germany.

FRIDAY, NOVEMBER 21.

9. "Vibration of Steamships; with Special Reference to Those of the Second and Higher Periods." By Rear Admiral George W. Melville, Engineer-in-Chief, U. S. Navy, Vice-President.
10. "The Development of Modern Ordnance and Armor in the United States." By Rear Admiral Charles O'Neil, Chief of the Bureau of Ordnance, U. S. Navy.
11. "Remarks on the New Designs for Naval Vessels." By Rear Admiral Francis T. Bowles, Chief Constructor, U. S. Navy, Vice-President.
12. "The Tactics of the Gun." By Lieut.-Commander Albert P. Niblack, U. S. Navy, Associate.
13. "The Possible and Probable Future Developments in the Use of Electricity on Board Ships." By F. O. Blackwell, Esq.
14. "Submarine Boats; Their Present Development and Future Possibilities in Naval Warfare." By Lawrence Y. Spear, Member.
15. "Measurement Rules for Yachts; with Special Reference to Racing Conditions." By F. W. Belknap, Esq.
16. Prize Competition Paper.

QUERIES AND ANSWERS.

Q. 106 *a*.—Why is a four-cycle gasoline engine more economical than a two-cycle?

b.—Why is the rub, and hammer break, used on marine engines almost exclusively, and the jump spark on automobiles?

c.—Would not the jump spark work satisfactorily on a marine engine?

A.—(*a*) The four-cycle engine is usually more economical than the two-cycle of the enclosed-crank-case type, because the four-cycle usually employs a higher compression. By some authorities the difference has been attributed to the escape of a portion of the unburned mixture through the exhaust passages, and by others to the high percentage of burned gases remaining in the cylinder. In a well-designed two-cycle engine there should be very little difference between its fuel consumption and that of the four-cycle. On the very large two-cycle engines used in Germany for sizes ranging in the neighborhood of 500 to 1,000 horse power the two-cycle is found to be the more economical type. These engines, however, are of a somewhat different type than the enclosed-crank-case engines used on marine work in this country. (*b*) The question would have been better put if it had been, Why is the jump spark used on automobiles? Answering this form of the question, the automobile engines run at very much higher speed than the hammer break will give good service. As the automobile engine runs at a great many different speeds, it is necessary to change the lead of the igniter to get the best results for the various speeds, and this can be more conveniently done with the jump spark than with the other type. However, the hammer break is not confined to the marine engine, nor the jump spark to the automobile, as the reader will find by reference to Mr. Roberts' article in the August issue. (*c*) The article referred to above answers this question.

Q. 109.—Where are the perpendiculars located in drawings of steamships? J. C. C.

A.—The term "perpendiculars" has reference to the dimension "length between perpendiculars." The location of the perpendiculars between which this length is measured varies in different countries and with different types of vessel. In the United States the after perpendicular is located at the after side of the stern post, while the forward perpendicular in planked ships is located where the water line cuts the forward edge of the stem rabbet, while in iron ships it is located where the water line cuts the forward edge of the stem. The horizontal distance between these two lines is then called the "length between perpendiculars."

Q. 111.—Will you kindly answer in your valuable inquiry column the following question, which has more or less caused considerable expression of difference of opinion, viz.: What is the theoretical definition of a fraction of a pitch, the angle of the screw, and the length of the screw? H. W. J.

A.—We assume that in the inquiry you refer to a screw propeller. In the first place, you ask for a theoretical definition. There is no such thing. A definition is a brief description or characterization of the thing defined. It is neither theoretical nor practical; it is a definition.

"The term "fraction of pitch" applied to the screw propeller usually relates to the length of the blade fore and aft. Thus if the pitch is 16 feet, while the greatest fore-and-aft dimension of the blade is 2 feet, the fraction of the pitch actually employed in one blade is one

eighth. Thus in Fig. 1 we have the side view of a propeller blade. Then the extreme distance, AC, between the forward and after edges would be the fore-and-aft length of the blade, and this divided by the pitch would give the fraction of pitch.

To define the angle of a screw, imagine a cylinder of any given radius to intersect the propeller face. The line of intersection will be a part of a curve known as a helix. Then suppose the cylinder cut along an element parallel to the axis and rolled out flat, or "developed," as it is termed. In Fig. 2 let $ABCD$ represent this development, AB being the element parallel to the axis. Let PQ be the development of the helix resulting from the intersection of the surface of the

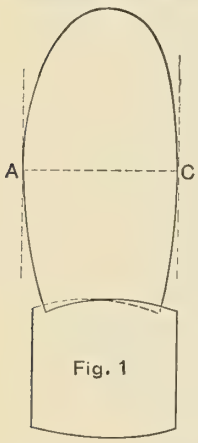


Fig. 1

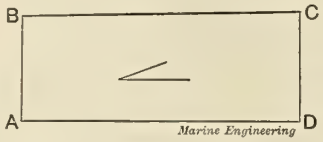


Fig. 2

cylinder with the propeller, and PR a line parallel with AD. Then the angle at P is the angle of the screw. It is easily seen that this angle varies continuously from hub to tip of blade, and without we know the radius at which it is taken the term "angle of screw" has no significance or value. With the radius it is easily shown that the value of the pitch is given by the equation:

$$p = 2\pi \quad r \tan \alpha$$

where p = pitch, r = radius, and α = angle.

By the term "length of screw" we suppose the fore-and-aft dimension is meant, as shown by AC in Fig. 1.

Oil for Torpedo Boat.—The torpedo boat *Talbot* is to be equipped with an oil-fuel-burning plant and sent to sea for a trial. Rear Admiral Melville is desirous of learning whether or not this fuel can be used on the naval ships satisfactorily.

Quarterly Shipbuilding Returns.—The Bureau of Navigation reports 348 sail and steam vessels of 103,421 gross tons built in the United States and officially numbered during the quarter ended September 30, 1902. During the corresponding quarter ended September 30, 1901, 393 sail and steam vessels of 68,395 gross tons were built in the United States and officially numbered.

Steam Yacht Helena.—From the premises of the Eastern Manufacturing Company, South Brewer, Me., the steam yacht *Helena*, belonging to Mr. Fred. W. Ayer, of that company, was recently launched. The vessel is 108 feet long over all, 91 feet 8 inches long between perpendiculars, 17 feet beam, and 10 feet 4 inches deep. Every part of the vessel was built by the above-mentioned company's mills.

TECHNICAL PUBLICATIONS.

Materials of Machines. By Albert W. Smith. Size 5 by 7 1-2 inches, pp. 142, with 17 figures and diagrams. John Wiley and Sons, New York. Price $1.

The author, in his preface, states that this book is the result of an effort to bring together concisely the information necessary to him who has to select materials for machine parts. The material is presented in five chapters dealing with the metallurgy of iron and steel, the testing of materials and stress-strain diagrams, cast iron, wrought iron and steel, alloys.

The author is thoroughly at home in his subject, both as a practical and experienced designer of machinery and as a teacher acquainted with the needs of students and the general reader seeking information in this field. He has succeeded most admirably in bringing together into a concise and convenient form a large amount of the most valuable information for all who are concerned with the metals chiefly used for engineering purposes. The style is simple and clear, the illustrations such as are needed to aid the text, and the book is a thorough success. It is brief, concise, and to the point, and contains the information which the average engineer will most need in connection with his intelligent selection of materials for various engineering purposes. The presswork and binding are in the well-known standard text-book style of the publishers.

Hawkins Emett, Diagramal Formulæ. Size 9 by 12 inches. Twenty-four blue-print plates, with leather cover. W. H. Collier Publishing Co., 234-235 Broadway, New York. Price $3.

This book consists of twenty-four formulæ worked out in diagram form and arranged conveniently for use by draftsmen, designers, and engineers. The formulæ cover the ordinary field of stationary steam-engine design and are intended to represent the best modern practice in standard construction of this type. Each sheet contains a statement of the operation required, with an illustrative example. One peculiar feature of the diagrams consists in the fact that the result to be obtained is not directly represented by the scales on the diagram, but is to be measured by a scale or rule applied to the diagram itself. In this way the diagrams are somewhat simplified, but it may be questioned whether their use would not have been a little readier with a self-contained scale for the result.

This collection of diagrams would be improved by an appendix showing just what formulæ are employed, what constants are used, what coefficients of safety are included, and in general by showing the engineering foundation of the diagrams and rules presented. As it is, the designer must either blindly accept the rule and result given by the diagram, or he must figure backward from the diagram to the formula in order to be able to form any independent judgment regarding its applicability to the circumstances of the case in hand.

Collections of diagrams of this kind are of great help to those who may not be able to derive formulæ for themselves or judge regarding their use in any given instance, and also to all who may have taken the trouble to test their character and establish to their own satisfaction the basis upon which they are developed. For the trained designer they will hardly be satisfactory without some means of enabling him to judge regarding their applicability to his problems, or to modify them

in accordance with his judgment. He will not care to follow blindly the dictates of a rule or diagram the character or foundation of which is not clearly manifest.

With such additions as to show clearly the foundation of the various diagrams, the acceptability of the book would be much enhanced. As it is published the lack of such explanation will be likely to render the book less acceptable to the large body of designers who do not wish to work blindly and who are accustomed to employ judgment as well as methods of computation for the determination of their structural details and dimensions.

Submarine Warfare, Past, Present, and Future. By Herbert C. Fyfe. Size 5 1-2 by 9 inches, pp. 332. With 50 illustrations. Price $3. E. P. Dutton and Co., London and New York.

The apparent present-day interest in submarine boats and submarine warfare, and the lack of a popular work in the English language relating to these subjects, are the reasons which have induced the author to prepare this work. The introduction to the book is written by Admiral Fremantle, and a chapter on the probable future of submarine boat construction by Sir Edw. J. Reed. The subject matter of the book is presented in three parts, consisting, first, of a general discussion of the subject of submarine warfare; second, of a general history of the development of submarine navigation; and, third, of a series of appendices giving more detailed information regarding recent designs and construction in Europe and America. The subject is purposely treated in a popular rather than a purely technical manner, while at the same time a large amount of information is given regarding the design and characteristics of the latest types of submarine construction. In the chapter on the mechanism of the submarine the author gives an interesting discussion on the various means available for propelling submarine boats, as well as for exercising the necessary control when submerged. Various problems of stability, control, respiration, safety, habitability, armament offensive and defensive, are given a due share of consideration. The historical development of the subject gives evidence of wide reading and a careful selection of the material available. The work of the early inventors in this field is given due recognition, while naturally the chief attention is paid to the developments of recent years, and to the types of submarine boat which may properly be called modern. The Holland submarine boat naturally comes in for the most complete description, while at the same time suitable recognition is given to the Lake submarine and also to the early efforts of Bushnell, Fulton, and others in the United States. Similar description is also given to the various European designs in the same field, and the designs proposed more especially in France and Spain are described with like completeness.

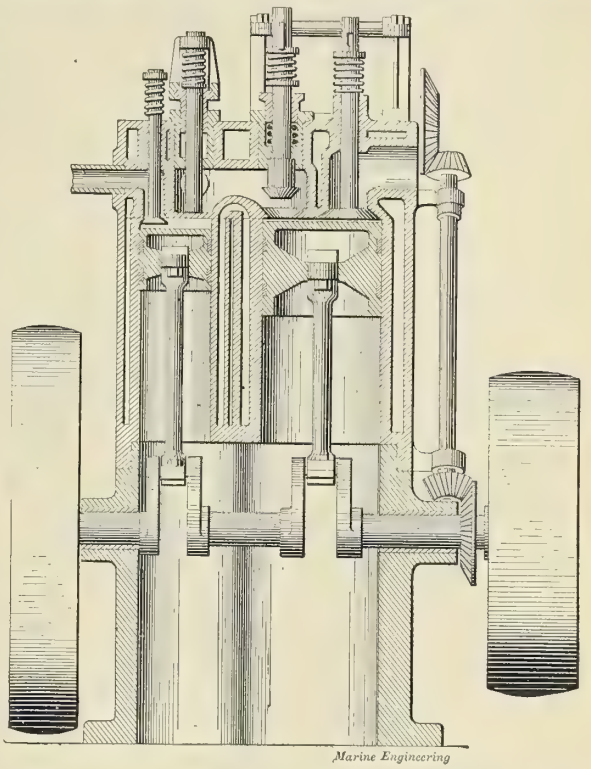
As a whole, this book will prove a very acceptable addition to the literature of marine warfare and will be found of great interest not only to those who are technically concerned with naval warfare in its various aspects, but also to the general reader who is desirous of acquainting himself with the history of this type of marine construction, with a fair statement of its possible relation to the art of naval warfare, and with the developments along these lines during the past decade.

SELECTED MARINE PATENTS.

708,153. OAR ATTACHMENT. MONS A. LINDER, PULLMAN, ILL. Six claims.

708,227. STEAM TURBINE. ROBERT B. HEWSON, SAN FRANCISCO, CAL. Seven claims.

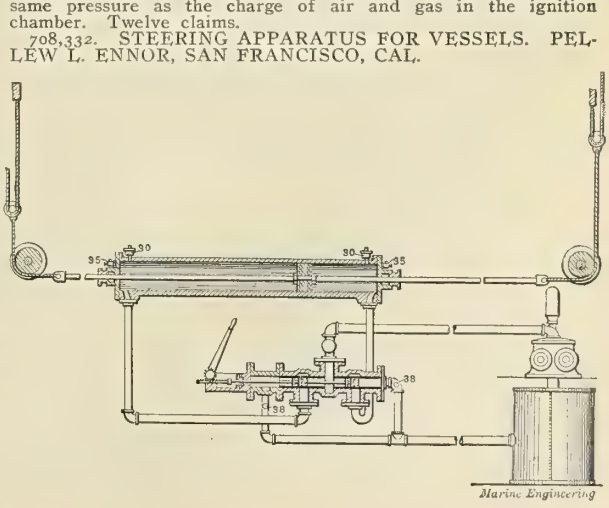
708,236. GAS ENGINE. WILLIAM A. LEONARD, WAREHAM, MASS.



Marine Engineering

CLAIM.—1. In a gas engine, a power cylinder, a pump cylinder, a single cylinder head for both said cylinders, an inlet port, leading through the cylinder head and opening into the end of the pump cylinder, an exhaust port for the power cylinder, also extending through the cylinder head, an ignition chamber in said cylinder head and having communication with each cylinder, a puppet valve controlling the inlet port to the pump cylinder, a second puppet valve controlling the exhaust from the power cylinder, a third puppet valve controlling the communication between the pump cylinder and the ignition chamber and a fourth puppet valve controlling the inlet between the ignition chamber and power cylinder, all of said valves being carried by and operating in the cylinder head, and each of said valves being independent from the others and when closed having its face flush with and constituting part of the end of the cylinder, positive valve-actuating mechanism for the valve controlling the inlet to the power cylinder and that controlling the exhaust therefrom, said mechanism operating to close the inlet valve at the finish of the outward stroke of the power piston, and also operating to close the valve in the exhaust port before the power piston reaches the end of its inward stroke, whereby the gases remaining in the power cylinder are compressed to substantially the same pressure as the charge of air and gas in the ignition chamber. Twelve claims.

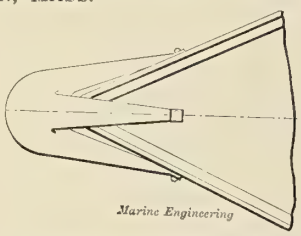
708,332. STEERING APPARATUS FOR VESSELS. PELLEW L. ENNOR, SAN FRANCISCO, CAL.



Marine Engineering

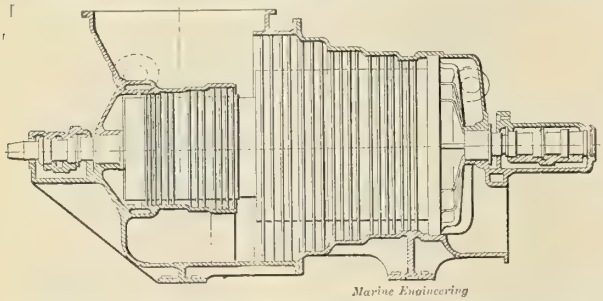
CLAIM.—In hydraulic steering apparatus, the combination of a main steering cylinder provided with air-escape valves 30 and water-escape valves 35, a controlling cylinder provided with air-inlet valves 38, a force pump for maintaining pressure in the system, a tank for receiving the circulating liquid, a pipe from the pump to the controlling cylinder, return pipes from the controlling cylinder to the tank, and pipes from the controlling cylinder to the main steering cylinder. One claim.

708,476. FENDER FOR BOATS. WILLIAM H. HIGGINS, BOSTON, MASS.



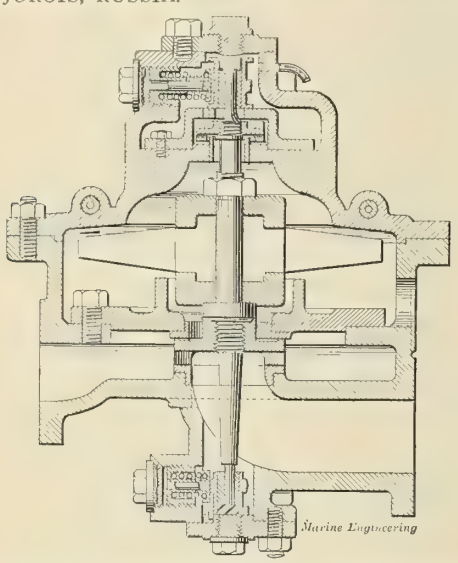
CLAIM.—1. A fender for boats consisting of two flexible triangular members sewed together around their edges, stuffing between them, means for securing the prongs to the boat, and a web for attaching the center of the device to the boat, as and for the purpose set forth. Four claims.

708,780. STEAM TURBINE. CHARLES A. PARSONS, NEWCASTLE-UPON-TYNE, ENGLAND.



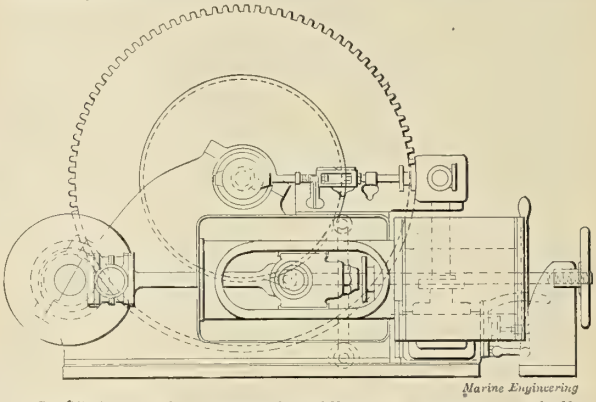
CLAIM.—1. In parallel-flow turbines, in combination, a complete main turbine having its own casing and its own drum and having a plurality of rings of blades supported from said casing and a plurality of interspaced rings of blades supported from said drum, an exhaust passage leading from said main turbine, a complete reversing turbine having its own casing and drum and having a plurality of rings of blades carried by the casing and a plurality of interspaced rings of blades supported from the drum, said turbines being mounted on the same shaft, and the exhaust end of the reversing turbine being connected with the said exhaust passage from the main turbine inside the main turbine casing. Four claims.

708,815. STEAM TURBINE. ALBERT KRANK, WARKAUS JOROIS, RUSSIA.



CLAIM.—1. In steam-jet turbines, the combination, with an enclosing casing a rotary shaft passing through the interior of the casing, bearing boxes located at each end of the casing to receive the ends of the shaft, means for supporting and permitting the bearing boxes to have motions in directions parallel with the axis of the shaft, spring-actuated devices for normally maintaining the bearing boxes coincident with the axis of the casing, a steam-jet turbine wheel fixed on the said shaft, a chamber in the casing within which chamber the wheel is located, jet nozzles entering the turbine-wheel chamber to deliver the steam jets to the vanes of the wheel, and a steam-exhaust aperture to the said wheel chamber; of a second chamber within the casing through which also the turbine shaft passes, a dividing wall between the chambers, devices for preventing intercommunication of the contents of the chambers by leakage around the shaft and for permitting the elastically-held rigid shaft to have automatic lateral adjustment so that it may assume its natural axis of rotation, a centrifugal pump disk fixed on the shaft within the second chamber, a fluid-supply passage to the centrifugal pump disk by which fluid is pumped into the second chamber and maintained at pressure therein, and an exit pipe from the second chamber by which the pressure fluid is conveyed for either direct utilization or for driving secondary machinery. Five claims.

708,818. WINDLASS. FRANK S. MANTON, PROVIDENCE, R. I.



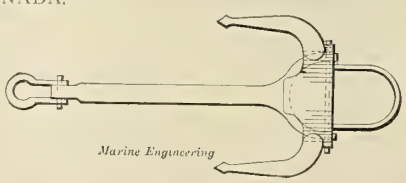
CLAIM.—1. An automatic riding or anchorage windlass equipped with surge-relieving mechanism and comprising a main shaft serving as a valve-actuating shaft, an engine, an engine shaft geared to the main or valve-actuating shaft, a pressure valve having means controllable by said valve-actuating shaft to vary the fluid pressure in the engine, a wildcat or chain wheel mounted directly and loosely on the valve-actuating shaft and capable of turning freely thereon in paying out the anchor chain, and a clutch for making said wildcat fast directly to the valve-actuating shaft and causing the latter to directly transmit the strain to the engines and to actuate the pressure valve. Five claims.

709,861. CUTTER HEAD FOR HYDRAULIC DREDGES. LINDON W. BATES, CHICAGO, ILL. Fourteen claims.

710,054. DREDGER AND EXCAVATOR. ISAAC B. HAMMOND, PORTLAND, OREGON.

CLAIM.—1. The combination with the dredge ladder and the tumblers for the dredge chain, of an endless dredge chain and buckets; traveling carriers therefor, attached below the chain and narrowed toward the base, so that such carriers in width occupy only a portion of the space within the span of the buckets; a railed way extending the length of the upper surface of the ladder leading from and to the tumblers; a railed way extending from the upper tumbler along the under surface of the ladder for a part of its length, being disconnected at a convenient point, allowing enough of the dredge chain and buckets at the lower end of the ladder to hang free, to provide sufficient drag; and a guard for holding the chain carriers traveling along the railed way on the under side of the ladder against a lateral thrust or strain, the tumblers being adapted to allow the traveling carriers to pass between their sides while the chain passes over their rims. Six claims.

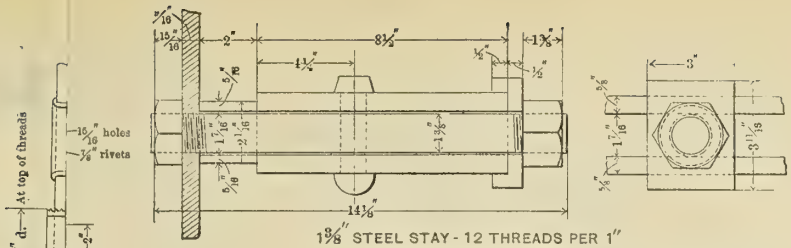
710,167. ANCHOR. JAMES A. PETTES, GRAND MANAN, CANADA.



CLAIM.—In an anchor, the combination, with a shank, of a ring pivoted to the lower end of the shank and having scoop-shaped projections on its upper edge, and flukes having curved lower portions which project laterally from the sides of the said ring between the scoop-shaped projections, and flukes being arranged at a greater distance from the shank than the said projections and terminating in barbed points. One claim.

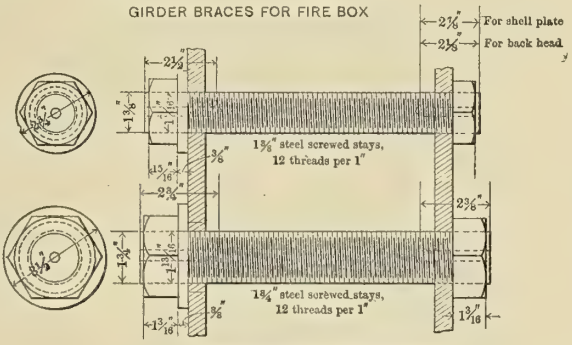
710,275. LIFE PRESERVER. CHARLES HUNT, BELFAST, IRELAND. FILED NOV. 15, 1901. Two claims.

Tremont's Speed.—The steamship *Tremont*, which arrived in San Francisco on September 24, made the trip from New York around the Horn in 54 days, or at an average speed of 12.35 knots. The *Tremont* was built by the Maryland Steel Company for the Boston Steamship Company, and with the other vessels of this fleet will be used in the Asiatic service.

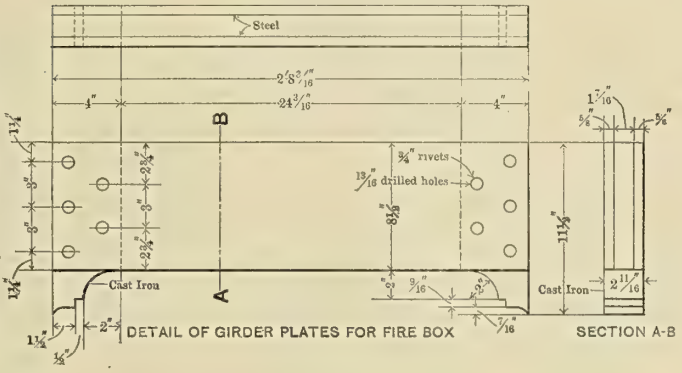


1⅜″ STEEL STAY - 12 THREADS PER 1″

GIRDER BRACES FOR FIRE BOX

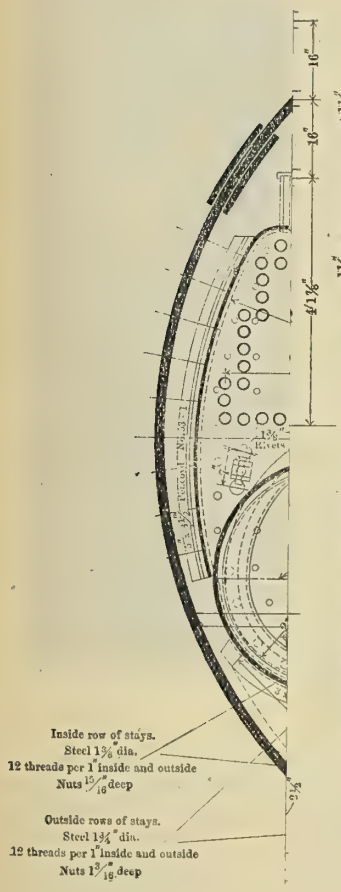


SCREWED STAYS FOR FIRE BOX



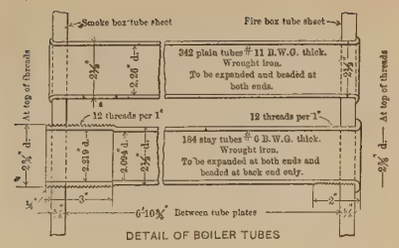
DETAIL OF GIRDER PLATES FOR FIRE BOX

SECTION A-B

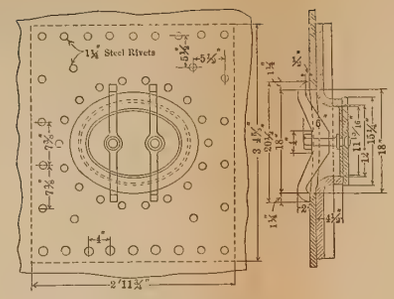

Inside row of stays.
Steel 1¾″ dia.
12 threads per 1″ inside and outside
Nuts 15/16″ deep
Outside rows of stays.
Steel 1¾″ dia.
12 threads per 1″ inside and outside
Nuts 1 3/16″ deep

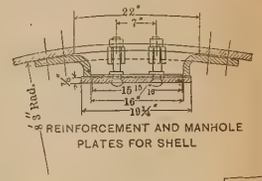
BOILER DATA.

Dia. inside		16′6″
Length		10′5″
Pressure		160 lbs.
Heating Surface	Tubes	2373.2
	Furnaces	168.5
	Combs. Chamber	226.3
Total, 1 boiler		2768 sq′
Grate surface		83 sq′
Ratio H.S. to G.S.		31.4
No. of plain tubes # 11 B.W.G.		342
" " stay " # 6 "		184
Total		526

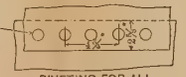

Smoke box tube sheet
Fire box tube sheet
342 plain tubes # 11 B.W.G. thick. Wrought iron. To be expanded and beaded at both ends.
12 threads per 1"
184 stay tubes # 6 B.W.G. thick. Wrought iron. To be expanded at both ends and beaded at back end only.
At top of threads
6'10¾" Between tube plates

DETAIL OF BOILER TUBES

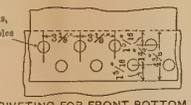




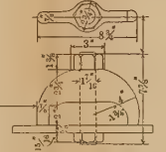
REINFORCEMENT AND MANHOLE PLATES FOR SHELL



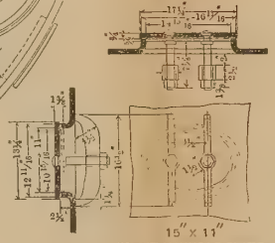
RIVETING FOR ALL SINGLE RIVETED JOINTS



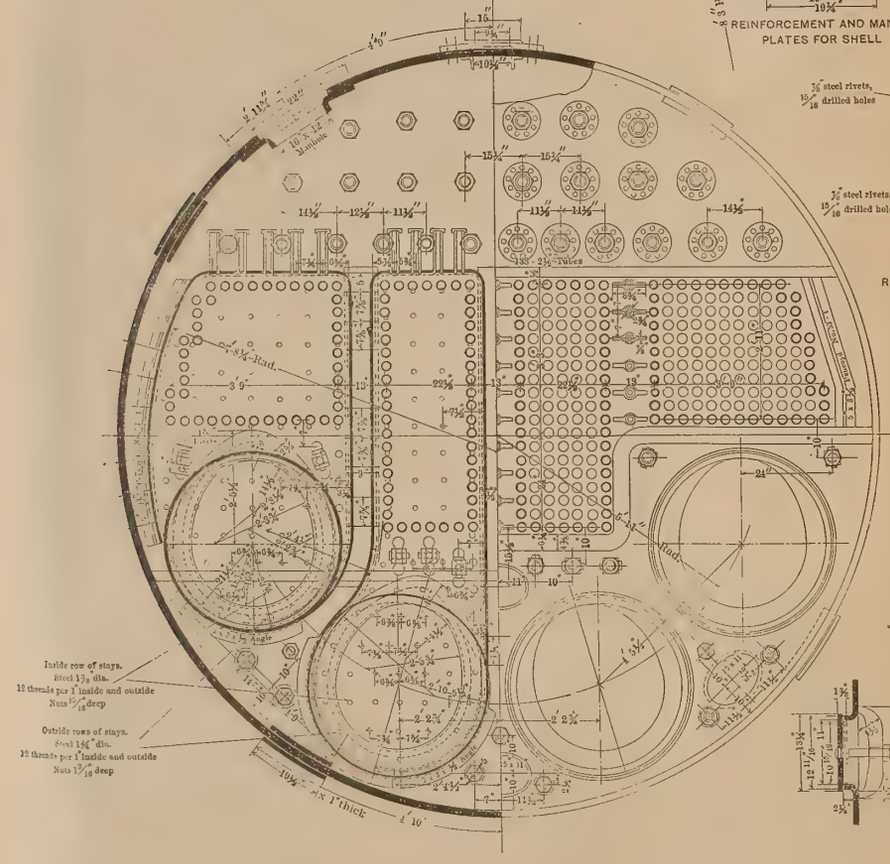
RIVETING FOR FRONT BOTTOM LAP

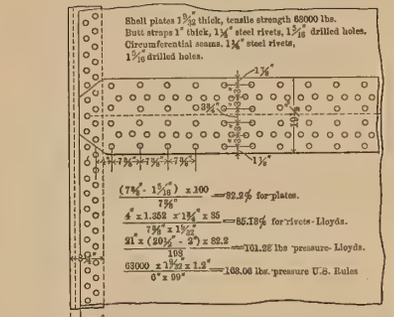


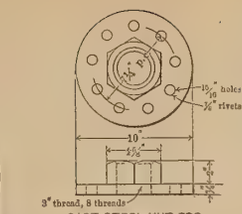
DOGS FOR TUBE SHEET



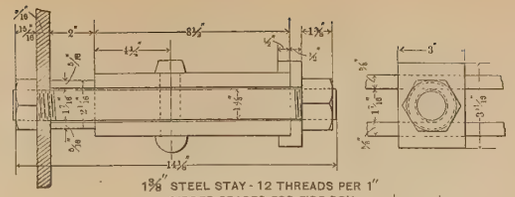
FRONT MANHOLE PLATE

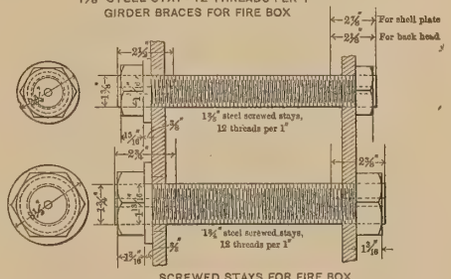

16" Rad.
Inside row of stays. Steel 1⅞ dia. 12 threads per 1" inside and outside Nuts 5/16 deep
Outside rows of stays. Steel 1¾" dia. 12 threads per 1" inside and outside Nuts 13/16 deep
10¾" x 1" thick
4'10"

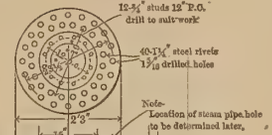

Shell plates 1 29/32" thick, tensile strength 60000 lbs.
Butt straps 1" thick, 1¼" steel rivets, 15/16" drilled holes.
Circumferential seams, 1¼" steel rivets, 1 5/16" drilled holes.
(7⅛" - 1 5/16") x 100 / 7⅛" = 82.2% for plates.
⅞" x 1.352 x 1¼" x 85 / 7⅛" x 1 29/32 = 85.13% for rivets - Lloyds.
21" x (10¾" - 2") x 82.2 / 103 = 101.28 lbs. pressure - Lloyds.
63000 x 1 29/32 x 1.2" / 6" x 99" = 168.06 lbs. pressure U.S. Rules

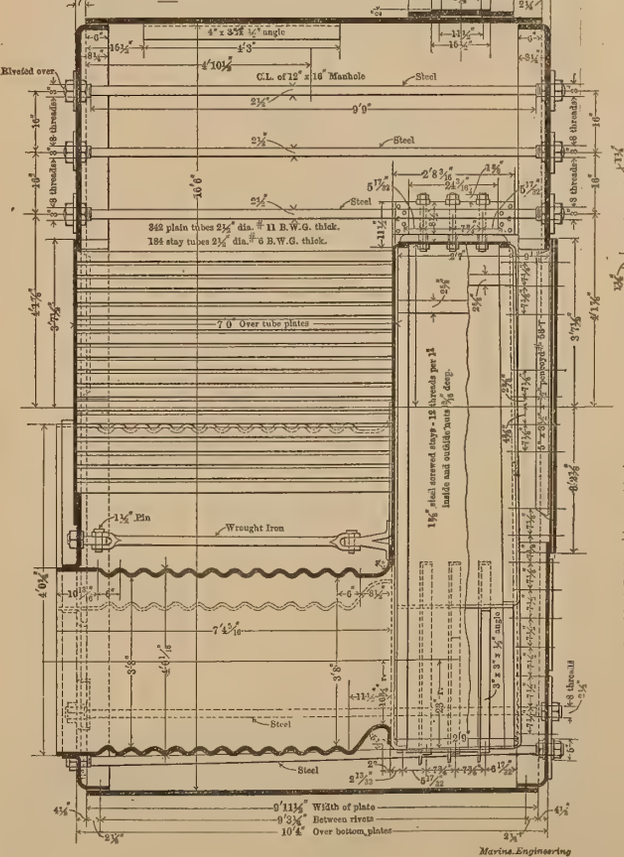


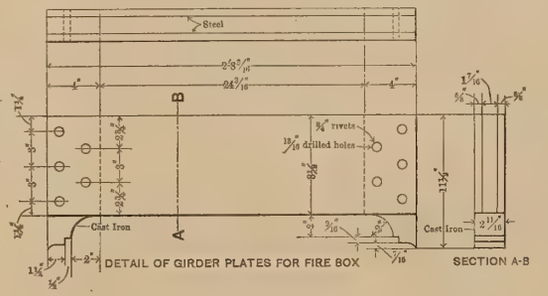
CAST STEEL NUT FOR THROUGH STAYS






12-¾" studs 12" P.C. drill to suit work
40-1¼" steel rivets 1 5/16 drilled holes
Note- Location of steam pipe hole to be determined later.


Riveted over
4" x 3½" x ½" angle
C.L. of 12" x 16" Manhole
Steel
342 plain tubes 2¼" dia. # 11 B.W.G. thick.
184 stay tubes 2¼" dia. # 6 B.W.G. thick.
7'0" Over tube plates
1¼" Pin
Wrought Iron
1¾" steel screwed stays - 12 threads per 1" Inside and outside nuts ⅝ deep.
9'11⅛" Width of plate
9'3¼" Between rivets
10'4" Over bottom plates



BOILER DATA.

Dia. inside		16'6"
Length		10'5"
Pressure		160 lbs.
Heating Surface	Tubes	2373.2
	Furnaces	168.5
	Combs. Chamber	226.3
Total, 1 boiler		2768 sq. ft.
Grate surface		88 sq. ft.
Ratio H.S. to G.S.		31.4
No. of plain tubes # 11 B.W.G.		342
" " stay " # 6 "		184
Total		526

Marine Engineering

FOUR-FURNACE SINGLE-END SCOTCH BOILER FOR THE CAPTAIN A. F. LUCAS, BUILT BY THE WILLIAM R. TRIGG COMPANY.

INDEXED

Marine Engineering

Vol. 7. NEW YORK, DECEMBER, 1902. No. 12.

DEC 15 1902

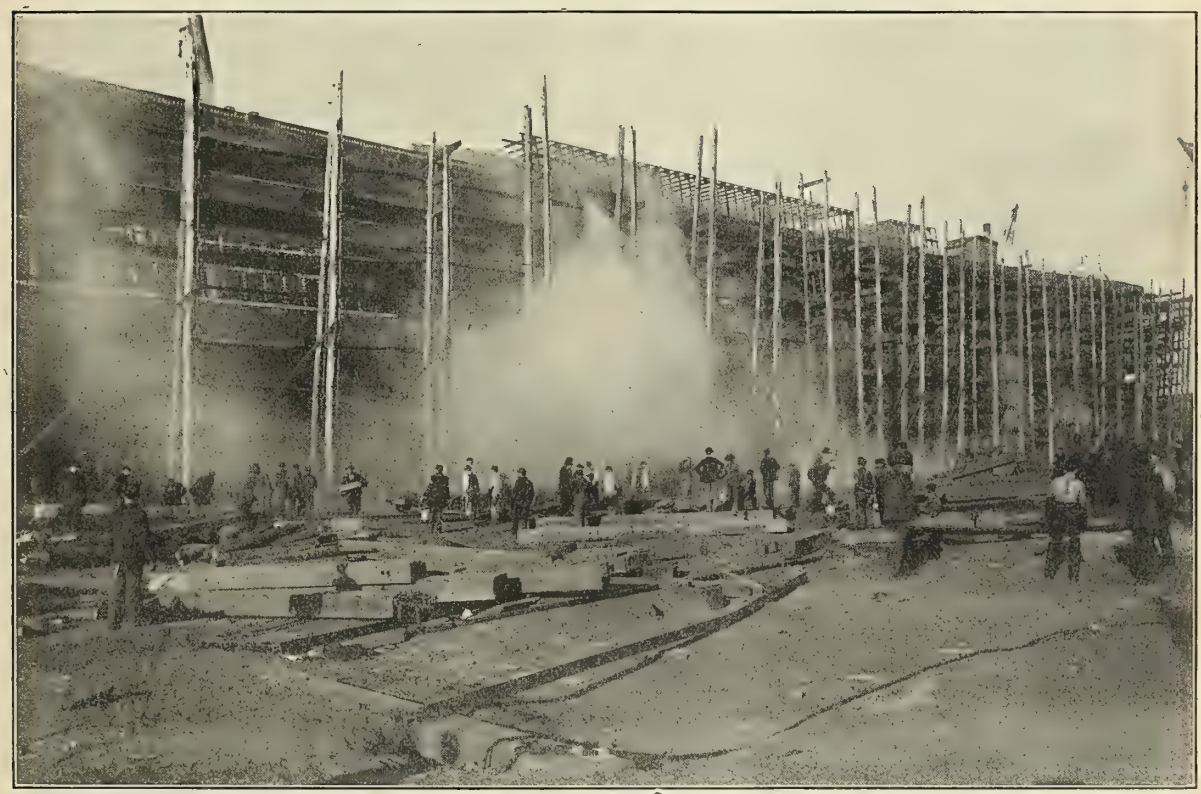
BURNING OF THE STEAMSHIP "MISSOURI."

The most serious fire in the history of shipbuilding, and one believed to be without a parallel, damaged the new steamer *Missouri*, building for the Atlantic Transport Company at the yards of the Maryland Steel Company, Sparrows Point, Maryland, during the afternoon of October 22, 1902. The ship was about ready to launch, the ways being greased, and the ship carpenters were engaged in replacing packing, etc.

The origin of the fire is unknown, not one of the 500 or more men employed around the slips seeing any indications of a conflagration until it was well under way.

Starting about the middle of the length on the port side, the fire quickly spread along the ways and through the staging and poles, and in less than five minutes from the sounding of an alarm the entire middle portion was a mass of flames. The fire department was promptly on hand and did all in its power to stay the spreading of the flames, but was unsuccessful, and until the arrival of several tugs from Baltimore the ship seemed doomed. The ways and shores on the port side for a distance of over 300 feet amidships gradually burned through, causing the ship to settle and heel to port, and for a time it appeared as though the ship would fall to the ground on her side. The keel blocks at the ends, which were the only ones now supporting the ship, were crushed into kindling-wood because of the great weight. Fortunately, however, the launching ways formed a resting place and held her at a list of about two feet.

The appearance of the ship during and after the fire can be seen from the illustrations. It is impossible at this time to determine the amount of damage sustained. The entire middle portion was surrounded by flames for an hour and a half, and the plates are now badly bent and distorted by the tremendous heat.



THE BURNING WAYS OF THE STEAMSHIP MISSOURI AT THE MARYLAND STEEL COMPANY.

The *Maine*, a sister ship, is building on the next ways, and every effort was made to prevent the spreading of the flames to her slip. Beyond a few charred shores and the staging and poles, no damage was done.

The problem which now presents itself to the builders is to right the steamer and raise her enough to launch,

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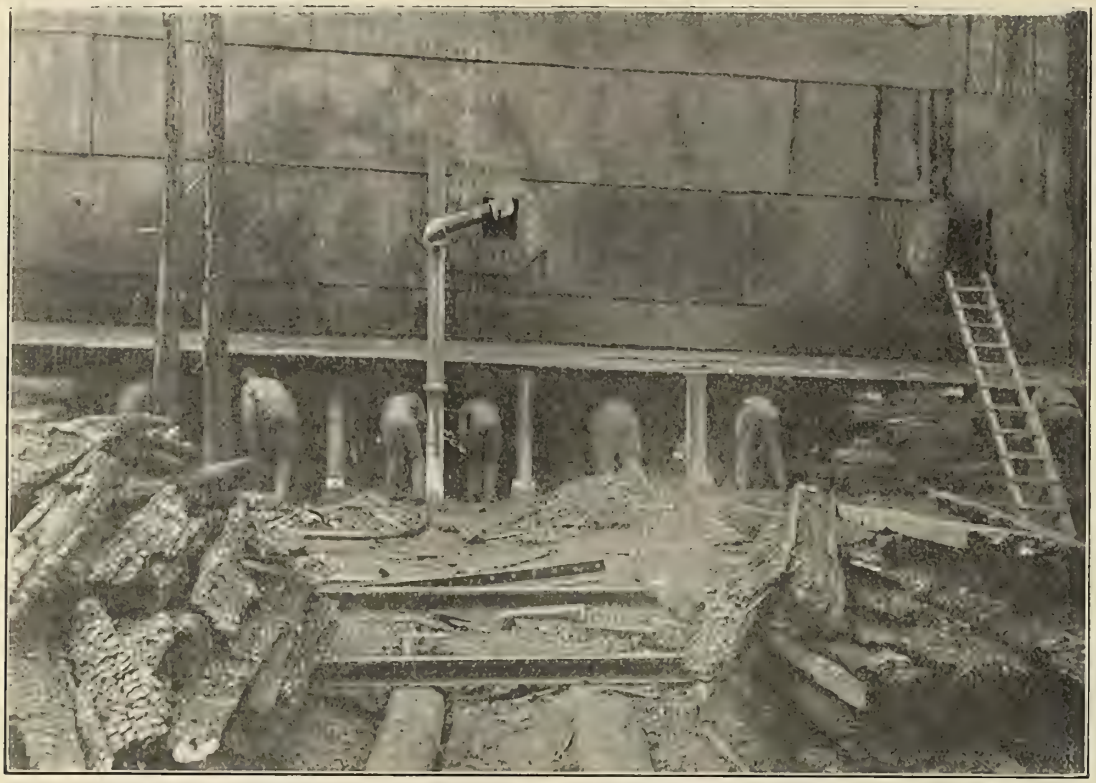


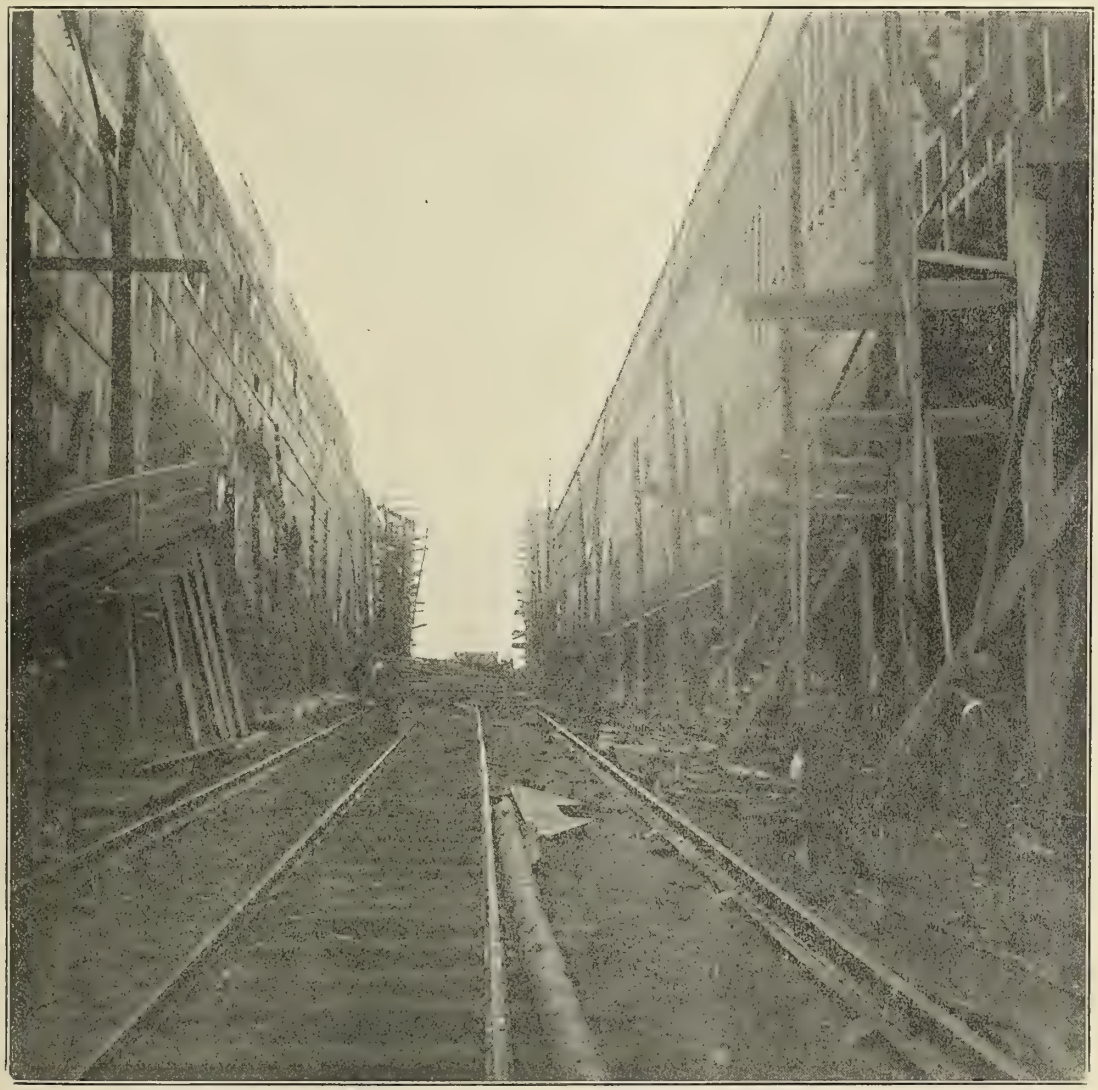
TAKING OUT THE BURNED SHORES AND BLOCKS.

The amount that the ship settled can be seen by the pipe at the middle of picture, which was formerly at the center of opening.

THE BURNED WAYS AND SHORING UNDER THE MISSOURI.

she having settled about two feet when the middle supports were burned out.

Much progress has been made in replacing the burned portions of the building ways, General Manager Mr. A. G. Wilson giving this his personal attention, and from present indications the work of righting and raising the *Missouri* will be accomplished before this article reaches the reader's hands.



BETWEEN THE SHIPS AFTER THE FIRE, THE MISSOURI AT THE LEFT, THE MAINE AT THE RIGHT.
The staging was burned from both ships at this point.

Trial of the Destroyer Stewart.—The torpedo-boat destroyer *Stewart* left the yard of the Gas Engine and Power Company and Charles L. Seabury and Company, Morris Heights, New York city, on October 20 and proceeded to Newport, where the trials were conducted two days later. The required speed was 26 knots, and the maximum speed attained over the measured course, with the corrections for tide, was 29.7 knots. Steam pressure at the boiler was 265 pounds, at the throttle 250 pounds, first receiver 80 pounds, second receiver 16 pounds; vacuum, 27 1-2 inches; average revolutions, 330. The trial was very successful and there were no mishaps of any kind.

GAS ENGINES AND THEIR TROUBLES.—VII.

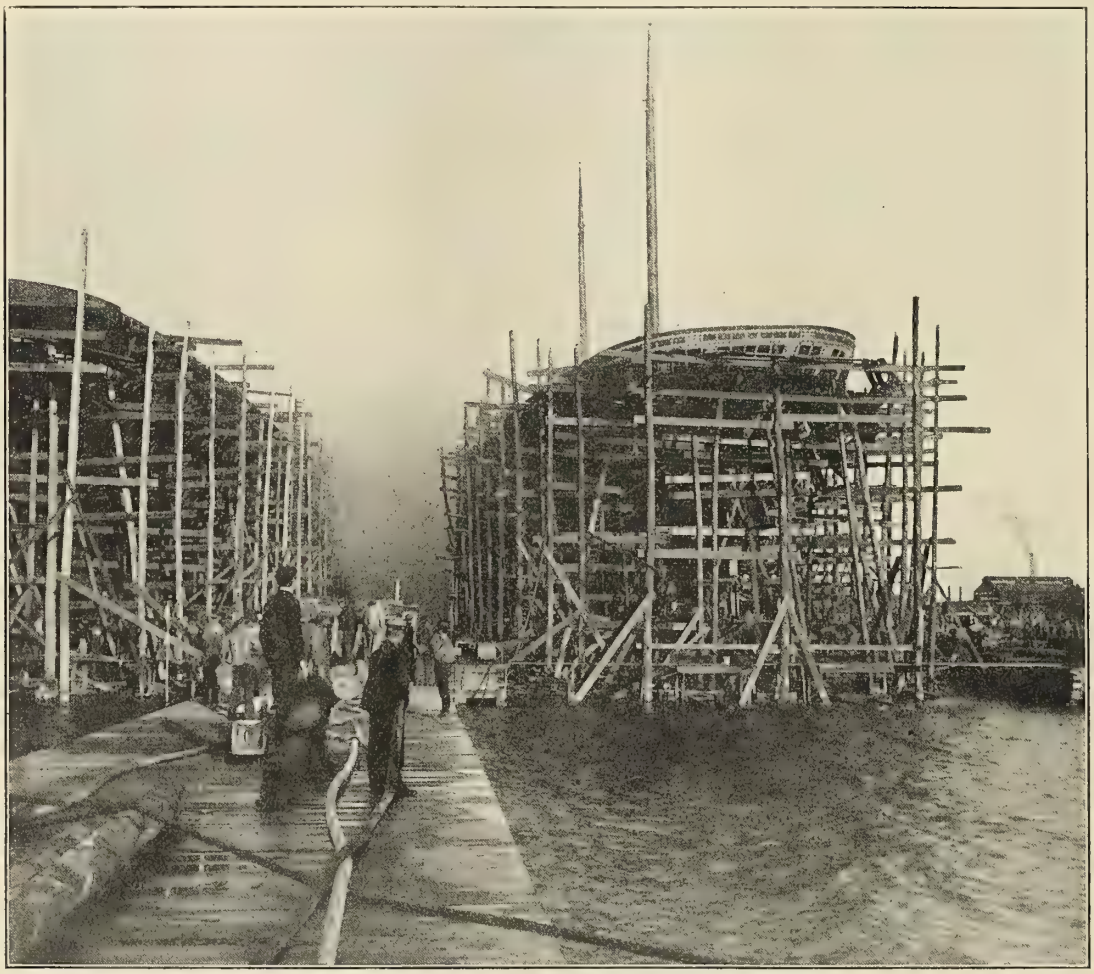
BY E. W. ROBERTS.

In order to illustrate, more pointedly than can be accomplished by a tabulation of possibilities, just how to set an engine in order that is acting badly, I will give a few actual examples of trouble-hunting, showing just what course is pursued when seeking the cause of the derangement. It must not be understood by the reader that when a certain set of symptoms have been traced to a certain source in the following accounts, a similar set of symptoms will in every case mean the same ailment. For instance, an engine may fall off in power from several different causes, any one of which will show the same symptom—*i. e.*, failure to develop the full power. Above all things, do not jump at conclusions, but go to work systematically and omit no test that indications do not prove to be absolutely unnecessary. It is by systematic working only that source of trouble can be found with any chance of promptitude.

As an example of what may occur from ignorance only, I was called upon one day to look at an engine

which was found hard to start and after being started would run some fifteen or twenty revolutions and then stop. In order to find out what was the matter I had the operator start it several times, for, as the engine was fresh from the factory, it was quite proper to assume that the operator was at fault. He seemed to think there was something the matter with his ignition, but I noticed, particularly when the engine seemed inclined to slow down, that he immediately gave the gasoline valve an extra turn, just as one would the throttle of a steam engine. I took the engine in hand and examined the electrical circuits, which were in good order, but on turning the engine over I found that some one had been "monkeying" with the igniter and that it was set to ignite half-way down the expansion stroke. I attempted to show the owner of the boat what was the matter, but he would not believe it was his fault, and I gave it up in disgust. As I was the only one in town who understood gas engines, he came to me a week later in sorrow and repentance, begging me to get his engine into working order, as he wanted to go on a trip. I made an appointment for the following morning at 8 o'clock, and going to the boathouse earlier than the appointed time, I advanced the lead of the igniter, and by the time the owner got there I was ready to start down the lake. While on that trip I gave the gentleman some strong words of advice, which he heeded, with the consequence that he had no more trouble with his engine the whole summer long.

Starting for the lake one day with a little four-horse-power two-cycle motor launch, it slowed up gradually and finally stopped altogether without any apparent cause. The gasoline valve was set properly, as I found upon examination, and had not been jarred out of position. Removing the wire from the insulated electrode and snapping it across one of the cylinder-head nuts, there was a good, bright spark, and upon turning the engine over to the ignition position it was found that the electrodes came together and separated at the proper time. I tested for this as follows: I kept scraping the wire on the insulated electrode, and turned the flywheel over slowly until such point was reached that a spark was produced when the piston was near the end of the stroke and just as the igniter mechanism showed that the electrodes should be brought together. Then just after the igniter snapped I could get no spark by scraping the end of the insulated electrode, showing that the electric circuit had been properly broken. The spark was bright and "fat," and the conclusion was that nothing was the matter with the igniter; but when testing the igniter I



FIGHTING THE FIRE OF THE MISSOURI FROM THE WATER.

found that the engine turned unaccountably hard and the cylinder was very hot. The heat extended back along the feed pipe from the circulating pump, and upon unscrewing the suction check the source of the trouble was revealed—the valve could not return to its seat on account of being clogged with dirt. After cleaning the valve and allowing the engine a few minutes to cool, it started up readily, and I went on my way rejoicing.

A case of jump-spark trouble on an engine that was designed for high speed for racing purposes was very difficult to trace. The engine—a two-cycle—ran very nicely at speeds under 500 r.p.m., but upon exceeding that speed misfires were frequent, while as soon as the engine was throttled down it ran steadily. It looked very much like a case of weak battery, but upon examination, even after running for some time, the battery showed no sign of falling off in pressure. A close examination of the wiring developed no loose connection, and the removal of the spark plugs showed them to be bright and clean, as were the contacts on the circuit breaker. Finally some one suggested that the springs on the circuit breaker were not stiff enough to let them bring the contacts together at the higher speed. Assisting the springs with the fingers while the engine was running showed this to be the probable cause of the trouble, as it helped matters greatly. In fact, stiffening up the springs solved the problem, and there was no further trouble from that source.

A four-cycle engine which had been running for some time had gradually fallen off in power until it could scarcely carry any load at all. A thorough examination of the igniter showed it to be in good working order, the mixer was set the same as it had always been, and there was no obstruction in the gasoline pipe, as was shown by opening the needle valve and allowing the fuel to run through. Disengaging the exhaust valve from the rocker arm which operated it, and turning the engine over slowly, the power which it took to move it as the piston neared the end of the stroke proved that there was no leakage past the piston. The suction was strong and there was nothing the matter with the inlet valve, and finally the trouble was laid at the door of the exhaust valve. It was found that the valve spring was weak, and upon tightening it up and grinding in the exhaust valve, which seemed to be leaking slightly, the engine ran as good as it ever had done.

In another case similar to the above the engine was falling off in power, and the customary routine was gone through with, examining the igniter, the mixer, and the valves, but without finding the source of the trouble, as everything seemed to be in fine working order. The engine was of the four-cycle type and employed an auxiliary exhaust port similar to the exhaust port in a two-cycle engine, the usual mushroom valve being just sufficient in size to allow the engine to clear itself on the exhaust stroke. It was finally decided to remove the cylinder head, and upon turning the piston toward the crank to the end of the stroke, examination of the auxiliary port was attempted, but, to the astonishment of all, no such port was in evidence. The man who was making the examination was from the factory where the engine was made, and as the engine had made a good showing on the testing block he was absolutely certain that the port was in place when the engine left the shop. Finally the reflection from the torch with which he was examining the cylinder showed him the outline of where the port had once been, and further investigation developed the fact that it was choked up tight with carbon, which had to be cut out with a cold chisel. On questioning the operator, it was found that gas-engine oil at 15 cents a gallon "wasn't good enough" for his engine, so he used a heavy steam-engine cylinder oil costing 60 cents a gallon, as he was quite certain that the price had a great deal to do with its adaptability to the engine. It was the heavy oil that had caused the hard deposit of soot, and the case was an excellent example of how not to do it.

The above instance of ignorance was, however, not quite so bad as that of the man in Memphis who, finding that he was short of oil, but had plenty of molasses, used the latter as a substitute. It is scarcely necessary to add that the piston was stuck in the cylinder. So poor was the quality of this lubricant, in fact, that the piston pin was in a very short time worn half in two. The greatest mystery about the affair is how the engine managed to run at all. It probably would not have done so had it not been for the fact that the molasses was used on the bearings for some time before it was introduced into the cylinder. It is needless to say that the repair man on this job gave the operator a short talk on lubricants.

A source of trouble which is often difficult to trace, and which is at the same time very annoying, is illustrated by the following example: A gentleman in St. Louis was running an engine which worked very well for a time, but finally developed a trait of starting off very nicely, but stopping after it had made some half dozen revolutions or so. No matter how often he tried, the engine would always stop after the first few strokes, but never failed to start easily. He wrote to me for a diagnosis, and I told him to start at the battery, examine it to see if it was weak, brighten up every connection and screw it up tight, see that his induction coil was perfectly dry, and examine his igniter for a short circuit. But, above all things, I told him to look for a vibrating connection. This is one which is usually developed by the wire breaking inside of the insulation, and although the ends are in contact while the engine is standing still, the vibration when the engine is running causes the ends to separate and come together, with the result that there are frequent misfires owing to the broken ends being parted at the same time the electrodes are separated inside the engine. Shortly afterward I received a letter from the man, saying that he had found a vibrating connection caused by the wire being held against the binding post of the coil by the frayed end of the covering. So soon as the engine started it would shake the wire away from the binding post, thus breaking the circuit.

A boat had just come in from a race after carrying off the first honors, and the engine had been allowed to cool down while the races for the higher-power boats were in progress. Although entered in another race, the boat did not start in it, and, being acquainted with the owner, I went to see what was the matter. Imagine my astonishment when I found he could not start his engine. He was rather crestfallen, as he had some ten miles to go home, and asked me to help him out. He said he had plenty of gasoline and a good spark, etc., but that the mixer valve seemed to be in bad shape, as the engine—

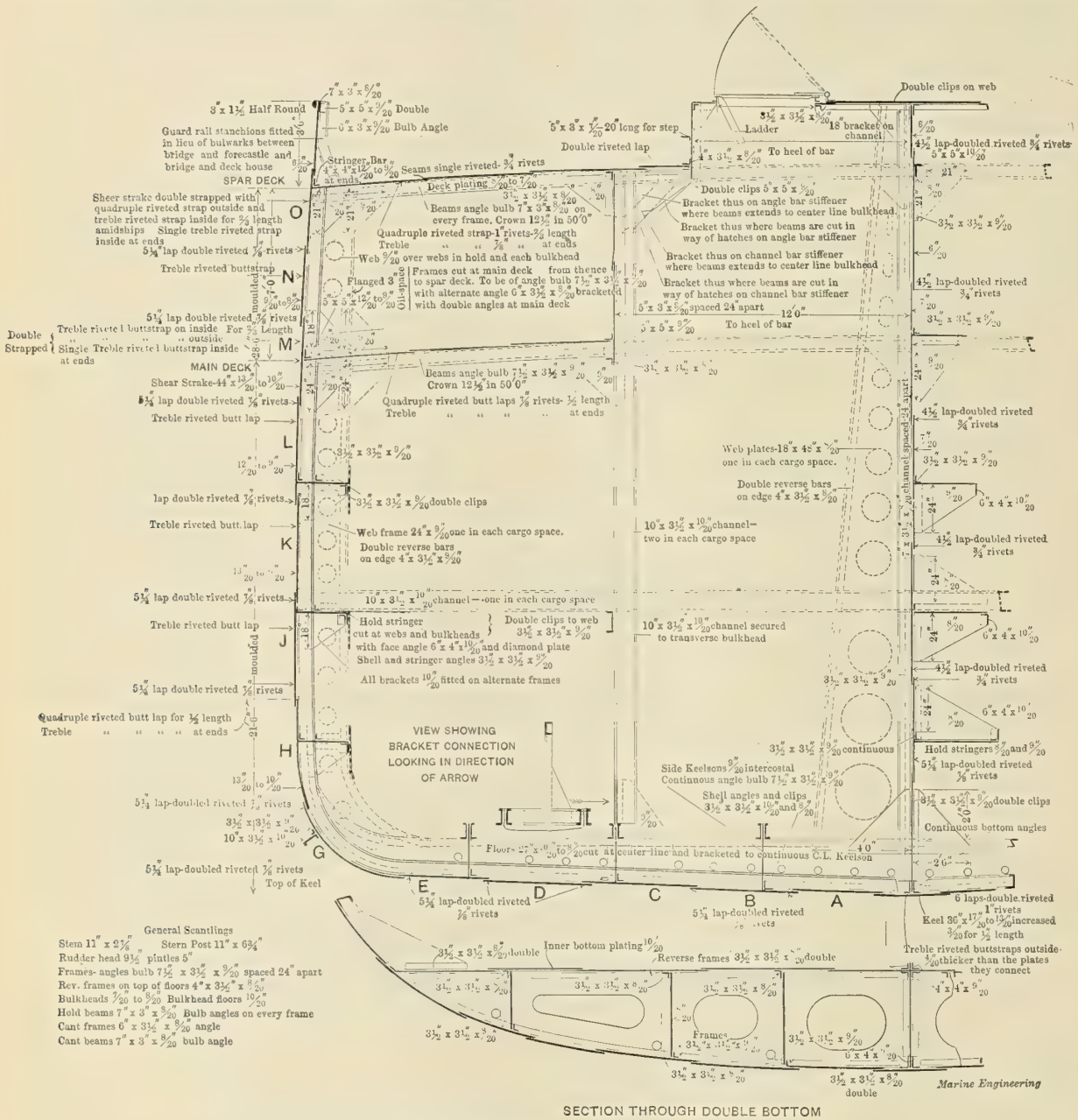
a two-cycle—was apparently flooded. Three of us took turns cranking the engine, in order to pump the gasoline out, but with no success. After quite a little cranking I noticed that there was very little odor of gasoline, such as there should have been had we been pumping the raw vapor into the exhaust. Thinking that possibly the gasoline valve might be clogged, I gave it about four times its usual opening, and, turning the engine over a couple of times, secured an explosion; and immediately closing the valve to its running position, I kept the engine going. It was a case of dirt in the gasoline pipe, and this was immediately removed by flushing the valve and connection when giving the valve such a wide opening.

(To be continued.)

NEW LARGE OIL-TANK STEAMER CAPTAIN A. F. LUCAS.

To meet the demand for transporting fuel oil, which has grown so enormously since the discovery of oil in Texas, a large fleet of oil carriers is now under construction both at home and abroad, including steamers and barges. Besides these specially-built vessels, several of our shipyards have been very busy remodeling freight steamers for carrying oil. It is never possible, however, to remodel a vessel built for one purpose, so that she will best be suited for another service. Oil-tank work is comparatively new, and in large vessels many new problems have been met with.

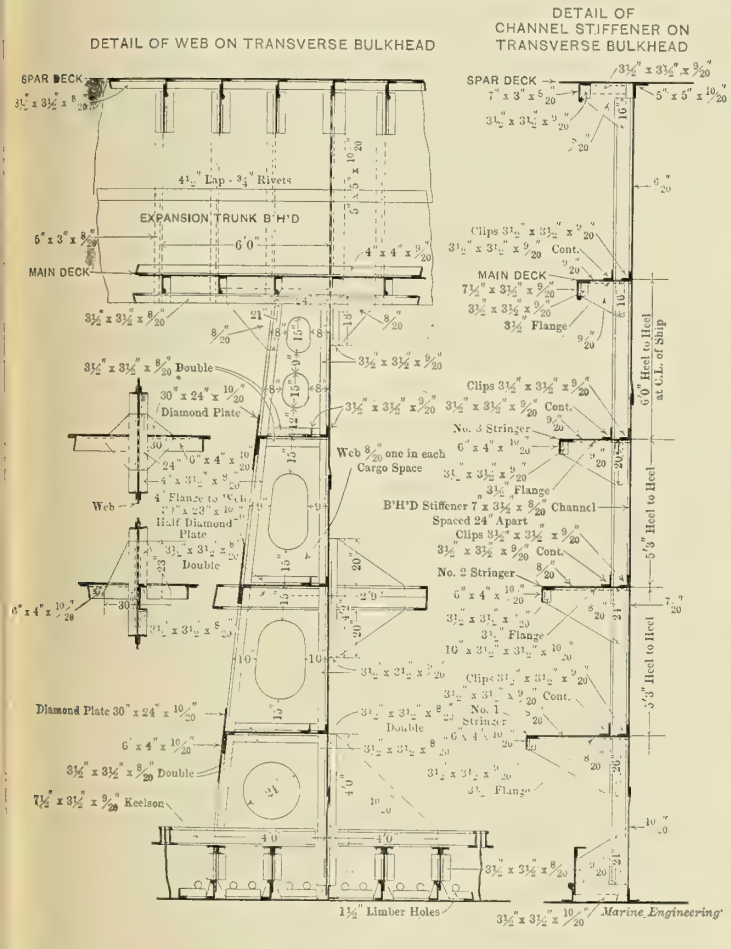
The largest of the American fleet yet laid down is that building at the yard of the William R. Trigg Com-



SECTION THROUGH DOUBLE BOTTOM

MIDSHIP SECTION OF STANDARD OIL TANK STEAMER CAPTAIN A. F. LUCAS.

pany, Richmond, Va., for the Standard Oil Company. The vessel is 360 feet over all and is designed to carry 1,500,000 gallons of oil in bulk and 700 tons of fuel oil on a draft of 22 feet 5 inches. The ship is of the spar-deck type, with complete spar and main decks, forecastle, bridge house, and a house aft around the machinery. She is built to the highest class of Lloyds and the American Bureau of Shipping, and the specifications call for a vessel built from the best material and equipped, when completed, ready for service in every respect.



DETAILS OF BULKHEAD STIFFENERS.

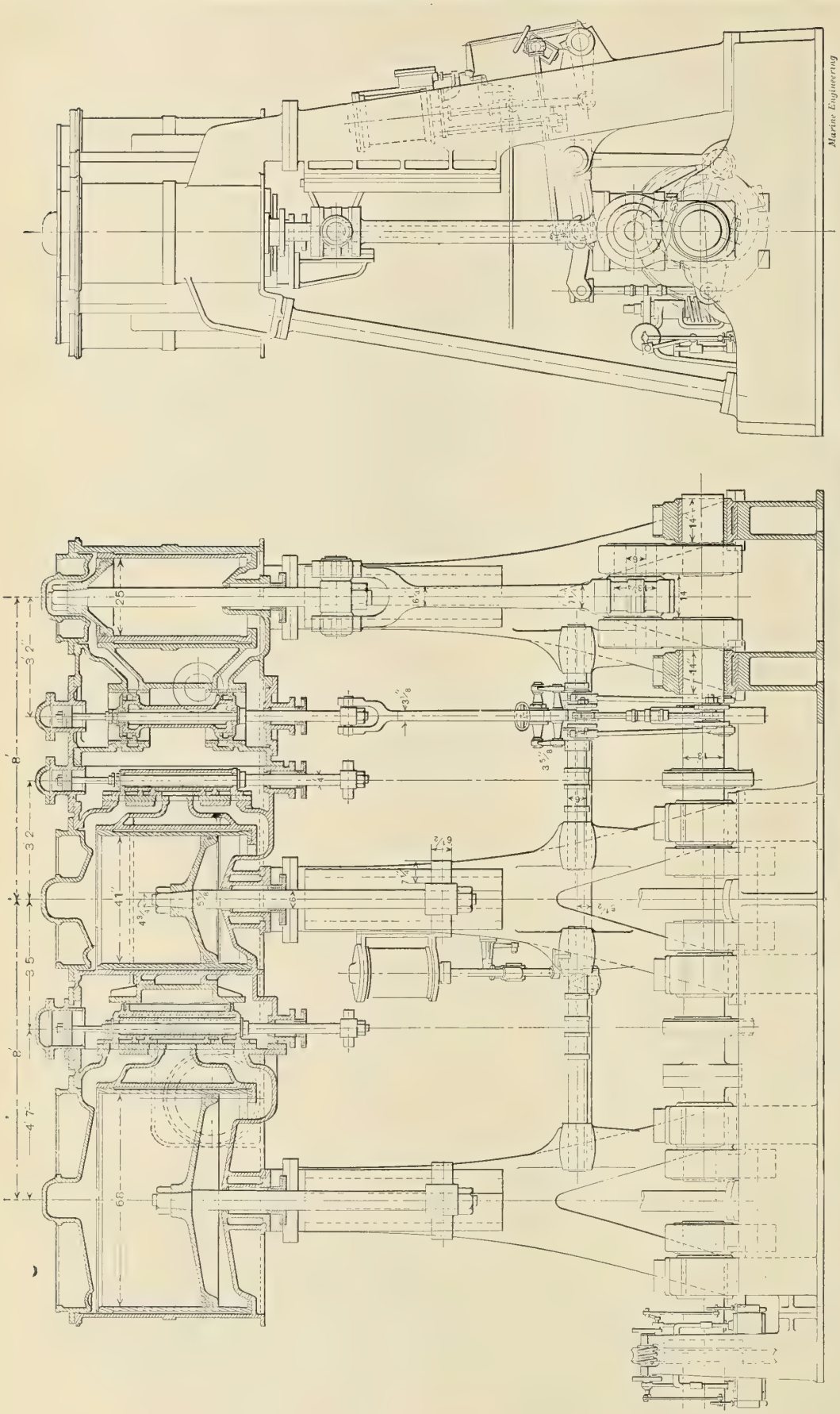
Any plates which are over 10-20 inch in thickness must have all the holes reamed. The stem is of hammered scrap iron 11 by 27-8 inches, tapered to 11 by 21-2 inches at the top. The stern frame is of cast steel 11 by 63-4 inches, in one piece with the rudder post, and the rudder is also cast steel with wrought-iron stock 9 1-2 inches diameter. The pintles are of forged steel 5 inches diameter, and the weight is carried by a bearing on the deck.

The frames, which are of 7 1-2 by 3 1-4 by 11-20 to 9-20-inch bulb angles, are spaced 24 inches. Forward of the collision bulkhead they are gradually brought together until they reach a spacing of 12 inches at the stem; between the main and spar decks are bulb angle and plain angle alternatingly, and the same in the forecastle. Alternate frames aft of the oil compartment extend to the spar deck. The framing on the bulkhead is 5 by 5 by 10-20 inch, and the edges are beveled for calking. The floors are 27 inches deep by 10-20 inch; at the ends the depth is increased and the thickness reduced to 8-20 inch, where they extend across in one piece. The flat plate keel is 36 inches wide and for half length amidships is 1 inch thick, gradually reducing to 13-20 inch at the ends. The center keelson, 60 inches by 12-20 inch, is continuous through the oil compartments, bunkers, boiler and engine rooms. There are three sister keelsons on each side, intercostal, with double angle bulbs on upper edge and well bracketed at the bulkheads. At the ends some of these keelsons are combined and connected by breast hooks. In each compartment and in the engine and boiler room spaces is a web frame 24 inches deep.

The shell plating is laid in outside and inside strakes, of dimensions given on the drawing, where will also be found the figures for the deck plating. In the forward hold and aft of engine room there is a lower steel deck. The main and spar deck beams are of bulb angle placed on every frame. The cargo space is divided into sixteen oil-tight compartments by nine transverse and one longitudinal bulkhead, each compartment made absolutely tight. The longitudinal bulkhead plates run horizontally, the transverse ones running vertically. The longitudinal bulkhead is stiffened by web frames, one placed in each tank on the port side. The transverse bulkheads are each stiffened by two web frames, one on each side of the bulkhead in alternate tanks. These frames are 4 feet wide at the bottom, and the transverse ones are 2 feet at the top, and on the longitudinal bulkheads they are 18 inches at the top, all of 8-20-inch plate. There are three horizontal stiffeners connected to the bulkheads and webs, as shown in the plan. All the webs and horizontal stiffeners are connected by diamond plates. A cofferdam of two bulkheads, one frame space apart, is arranged between the coal bunker and the after oil compartment. The forward bulkhead of this cofferdam is fitted between double angles. From the after cofferdam bulkhead to two frame spaces forward of after peak bulkhead extends a double bottom from the center line to the ship's sides.

Bilge keels extend for about 200 feet amidships and are made of bulb angle 10 by 3 1-2 by 10-20 inch with an angle iron 3 1-2 by 3 1-2 by 9-20 inch. The forecastle is 7 feet 6 inches high, decked over with Oregon pine. The bridge and after deck houses are the same height of 7-20-inch side plating. All doors are made of steel with water-tight fittings. The forward peak has a water-tight flat on a level with the lower deck, and in the upper forepeak are chain lockers.

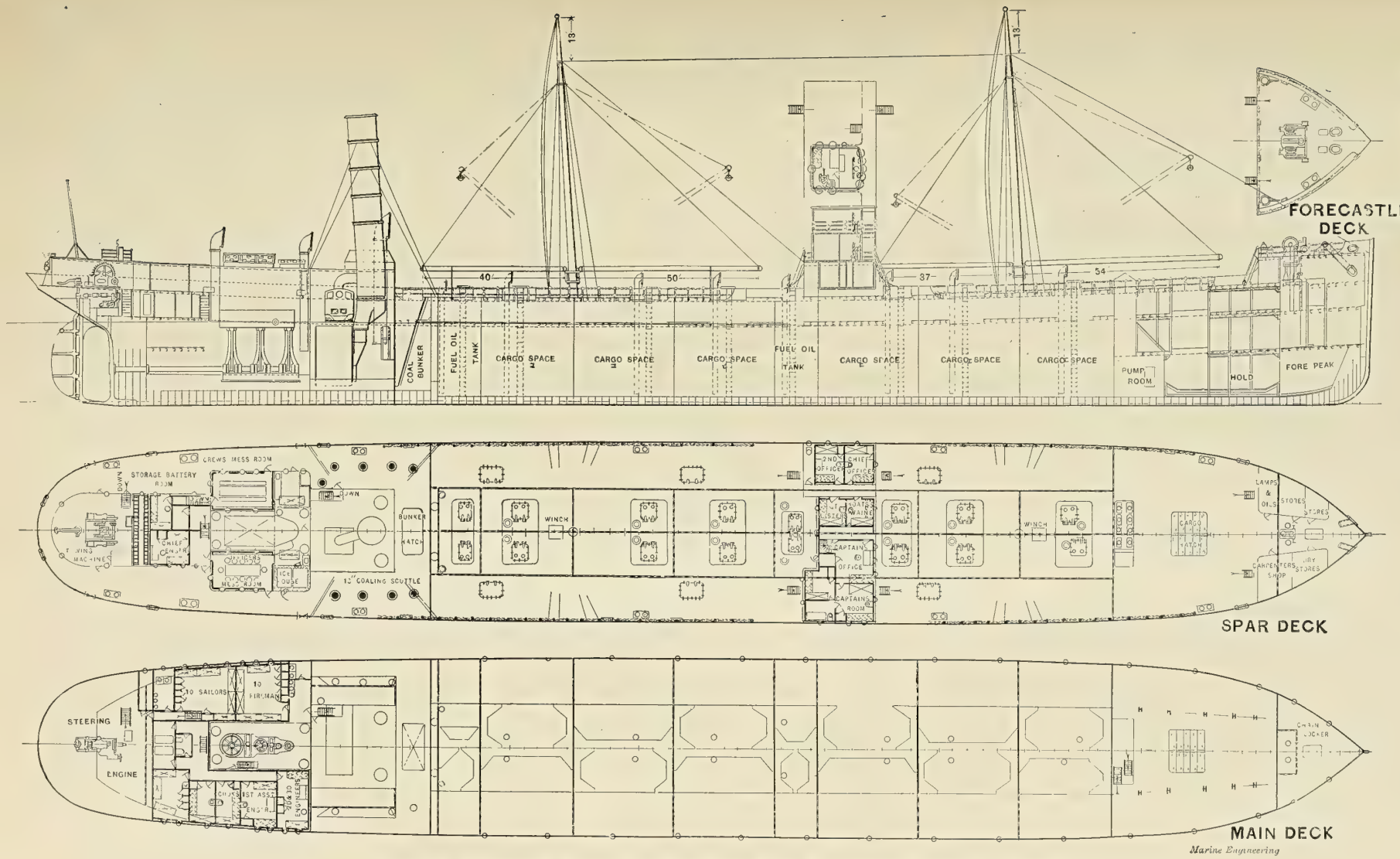
The riveting and calking has been done with extra care and the double bars on the cofferdam and end bulkheads are calked on both sides. Where possible, all calking and reaming was done with pneumatic tools. The size and pitch of the riveting is according to the rules, except in the cargo spaces, where the pitch will be 3 1-4 diameters. The countersinks are of uniform size, well filled, and the heads well laid up. When completed, all the oil compartments, the cofferdam, and the fuel-oil tanks are to be tested separately before the vessel is launched, and each compartment must be made absolutely tight with a head of water 10 feet above the top of the



ENGINES OF THE CAPTAIN A. F. LUCAS, BUILDING AT RICHMOND, VA., BY WILLIAM R. TRIGG COMPANY.

expansion trunk. The fresh-water tanks and double bottom are also to be tested. All work is to be made tight, iron to iron.

The general arrangement of the ship is well shown in the accompanying longitudinal and deck plans. It will be seen that the machinery is placed aft, leaving a clear space of 230 feet for cargo and oil fuel. The oil fuel is carried in two 'thwartship compartments, one about amidships and the other aft. The forward hold, which is 46 feet long, is fitted for carrying general cargo. An expansion trunk extends from the main to the spar decks, fore and aft, over the oil compartments at a distance of



SECTIONAL LONGITUDINAL ELEVATION AND DECK PLANS OF OIL TANK STEAMER CAPTAIN A. F. LUCAS.

12 feet from the center line. Over each compartment on the spar deck are located the cargo hatches, and in the top of each is fitted a small water-tight hinged door about 4 feet square. Smaller hatches are located above the fuel-oil tanks.

Forward of the oil compartments in the hold is a steel trunk extending down to the pump room, in which are located two oil pumps and one ballast and bilge pump with necessary suction and discharge valves. On each

side of the spar deck there are three side hatches, 4 by 6 feet, fitted with water-tight steel covers.

The ship is to have two steel masts 28 inches diameter at the heel, and short Oregon tops. The mast steps are of cast steel, placed on the spar deck directly above the transverse bulkheads. The four booms on each mast are of sufficient length to reach all the hatches, and a winch is placed at each mast. A large windlass is located on the forecastle for working the stockless anchors, which are to be stowed in hawse pipes. The two side lights are placed in steel light-house towers at the break of the forecastle.

Turning now to the crew's quarters, we find in the midship house commodious accommodations for the captain, second officer, chief engineer, quartermasters, and boatswains. Above is the pilot house, on top of this is the bridge.

On the spar deck, abreast of the engine hatch, are the officers' and crew's mess rooms, the galley, and quarters for the chief engineer and steward. The after end of the house is taken up by the towing machine. On the deck below are the quarters of the assistant engineers, oilers, sailors and firement, lavatories, and storerooms. The steering engine, which is of the Hyde type, is just forward of the rudder.

Bunkers for 500 tons of coal extend across the forward ends and sides of the fire room. Coal is loaded through nine iron coaling scuttles, and one large hatch on the spar deck.

Now turning to the machinery, the vessel is to be driven by a triple-expansion engine with diameters of cylinders 25, 41, and 68 inches, all having a common stroke of 42 inches running at 100 revolutions. The engine is designed to indicate about 2,000 horse power. The cylinders are of best cast iron, fitted with relief valves, drain cocks, indicator cocks, etc., lagged with magnesia and covered with Russia sheet iron with heavy brass strips. Each is fitted with a close-grained cast-iron lining. The high-pressure cylinder is fitted with a piston valve with cast-iron liner; the intermediate and low pressure are arranged for double-ported slide valve working on a false face. The valves are operated by the Lang radial valve gear, and reversing is accomplished by a steam engine mounted on the back framing of the intermediate pressure cylinder. The pistons are of cast steel, dished type, with packing rings and follower plate.

The piston rods and connecting rods with their bolts are of forged steel, which is the material also used for the slipper crosshead. The crank shaft is of forged steel, built up in two pieces with couplings forged on, and of 13 inches diameter. The crank pins are 13 1-4 inches diameter with a 6-inch hole. The webs are of cast steel. The thrust and propeller shafts are also of steel and the latter is covered with brass liners. Between the liners is a copper tinned liner with edges calked to prevent water getting at the shaft. The bed plate and back frames are of cast iron, the frames being of box shape, bolted to the bed plate. The front frames are of forged steel turned and finished.

The condenser is a separate iron casting of the cylindrical type, fitted with 3-4-inch brass tubes, giving a cooling surface of 4,500 square feet. The air pump is of the vertical duplex Blake type with cylinders 10, 22 by 15 inches. The circulating centrifugal pump is driven by a 12 by 10-inch engine. The main feed pump is also of the Blake vertical duplex style, 10 by 7 by 12 inches. A 20-ton evaporator is connected with the feed heater and condenser and is covered with magnesia. The necessary feed, fire, bilge, sanitary, and donkey pumps are provided.

The two boilers, which are arranged in a 'thwartship fire room, are of the Scotch single-end type, 10 feet 5 inches long by 16 feet 6 inches in diameter, and built for a working pressure of 160 pounds. The construction and detail of these boilers is given on the inset opposite page 599. The heating surface of one boiler is 2,768 square feet, made up as follows: 2373.2 in the tubes, 168.5 in the furnaces, 226.3 in the combustion chambers. There are four suspension furnaces of 48 inches outside diameter, each having separate combustion chamber. The tubes are of best charcoal iron, 2 1-2 inches diameter, and the plain tubes are of No. 11 B.W.G., the stay tubes of No. 6 B.W.G.

The boilers are provided with the Howden system of forced draft for burning either oil or coal.

The smokestack extends 80 feet above the grates. There is a water-tube donkey boiler, with 40 feet of grate and 1,200 square feet of heating surface, placed in the boiler hatch on the main deck.

Name—Capt. A. F. Lucas. **Nationality**—American. **Type**—Oil Cruiser,
Launched—190—. **Builders**—Wm. R. Trigg Co. **Owners**—Standard Oil Co.

Length over all	375 ft. 0 in.	**Auxiliaries:**	
" between perps	360 " 0 "	Condenser	...independent cast-iron cylindrical
Beam, molded	50 " 0 "	Cooling surface	4,500 sq. ft.
Depth to main deck, molded	21 " 6 "	Air pump	...vertical duplex Blake, 10x22x15 in.
Depth to spar deck, molded	28 " 6 "	Circulating pump, diameter of runner	36 in.
Displacement, light	about 3,000 tons	" size of engine	12x10 "
" loaded	9,000 "	Feed pump, vert'l duplex Blake,	10 x 7 x12 in.
Draft, loaded	22 ft. 5 in. mean.	Bilge "	7½x 7 x10 "
Dead weight carrying capacity	6,070 gross tons	Donkey pump	7½x 4½x10 "
Bunker capacity	500 "	Sanitary "	6 x 5½x 7 "
Fuel oil for boilers	700 "	**Propeller:** Four-bladed manganese bronze, solid	
Prismatic block coef.	.77	Diameter	16 ft. 0 in.
Tons per inch	37.4	Pitch	14 " 6 "
Engines:		Developed area	90 sq. ft.
Diameter cylinders	25, 41, 68 in.	**Boilers:**	
Stroke	42 "	Number	2
Valves, piston 15 in. on H. P., slide on I. P. & L. P.		Type	single-end Scotch
I. H. P., designed	2,000	Diameter	16 ft. 6 in.
Revolutions, designed	90	Length	10 " 5 "
Steam pressure, "	160 lbs.	Number of furnaces	four each
Vacuum, designed	26 in.	Furnaces, mean. inside diam	3 ft. 9½ in.
Diameter crank shaft	13 "	" length	7 ft. 4 15-16 "
" " pins	13¼ in.	Separate combustion chambers.	
" piston rod	6¼ "	Length of tubes over plates	7 ft. 0 in.
" connecting rod	6¼ "	Diameter of tubes	2½ "
Pistons	cast steel	Number of tubes, 342 plain No. 11 B. W. G.;	
Rev. gear, Lang-Radial type valve gear		184 stay No. 6 B. W. G.	
Length over all of engine	21 ft. 9 in.	Draft	Howden system
" of engine room	30 " 0 "	Length of boiler room	24 ft. 0 in.

TENTH GENERAL MEETING OF THE SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS.

The tenth annual meeting of the Society of Naval Architects and Marine Engineers was held on Thursday and Friday, November 20 and 21, in the assembly rooms of the American Society of Mechanical Engineers, 12 West Thirty-first street, New York city. The papers presented elicited much general discussion from members present.

The first regular session was called to order on Thursday morning at 10.30 o'clock with President Griscom in the chair. The first business was the report from the secretary-treasurer, which was received and adopted. The council presented the following lists of applicants to admission in the various grades of the Society. The names were read by the secretary and upon motion the applicants were unanimously elected members:

Members, 30.—Thomas Edward Artis, chief draftsman, Bath Iron Works, Bath, Me.; George Hale Barrus, mechanical engineer, 12 Pemberton square, Boston, Mass.; Francis Wyckoff Belknap, chief draftsman, Gardner and Cox, 1 Broadway, New York; Holden Allen Evans, assistant naval constructor, U. S. N., navy yard, Norfolk, Va.; Deltof Albert Hector, draftsman, Fore River S. and E. Co., Quincy, Mass.; Frederick Maxfield Hoyt, president, Greenport Basin and Construction Co., Greenport, N. Y.; William Hovgaard, professor of naval designs, Massachusetts Institute of Technology, Boston, Mass.; James McKinley, marine draftsman, Union Iron Works, San Francisco, Cal.; Albert J. Mickley, mechanical draftsman, Department of Docks and Ferries, New York city, N. Y.; Edmund Mills, in charge of marine department, The Babcock and Wilcox Co., Bayonne, N. J.; Leonard J. Nilson, proprietor, The Nilson Yacht Building Company, Ferry Bar, Baltimore, Md.; Charles O'Neil, rear admiral, U. S. N., chief of the Bureau of Ordnance, U. S. Navy, Navy Department, Washington, D. C.; Thomas Dorsey Pitts, chief draftsman, Tams, Lemoine and Crane, 52 Pine street, New York; Charles Bradley Rowland, assistant secretary and engineer, The Continental Iron Works, Brooklyn, N. Y.; Charles Schofield, superintendent, Eastern Shipbuilding Company, New London, Conn.; John Addison Baxter Smith, captain U. S. N., head of Department of Steam Engineering, navy yard, Brooklyn, N. Y.; John Amos Stevens, chief engineer, Merrimack Manufacturing Company, Lowell, Mass.; Frank Noyes Tandy, naval designer, 31 State street, Boston, Mass.; Philip Marshall Young, chief draftsman, Engine Department, New York Shipbuilding Company, Camden, N. J.; Rudolph Zirpel, superintendent of construction, U. S. Lighthouse Service, 525 Third street, N. E., Washington, D. C.; George H. Eimert, Axel B. Wallen, Arthur L. Busch, James F. Waddington, Edward Smith, Lieutenant Albert Moritz, U. S. N.; Rear Admiral P. C. Asserson, U. S. N.; Archibald Johnston, Antonius Jervis d'Athouguia, Perley F. Walker.

Associates, 19.—Adolph E. Boric, vice-president, Bethlehem Steel Company, South Bethlehem, Pa.; Philip B. Brill, calculating draftsman, Hull Department, William Cramp and Sons' S. and E. B. Co., Philadelphia, Pa.; David W. Dickie, draftsman in charge, office of supervising constructor, Moran Brothers Company, Seattle, Wash.; Edward Persall Field, 53 West Forty-sixth street, New York city; General Eugene Griffin, vice-president, General Electric Company, 44 Broad street, New York; Geo. McQuilken, Jr., electrical expert, Bureau of C. and R., U. S. N., Bath, Me.; Edward M. McIlwain, president, Bethlehem Steel Company, South Bethlehem, Pa.; Edwin Alan Perkins, naval architect and engineer, Maritime Building, New York, N. Y.; Matthew Bowen Pollock, carpenter U. S. Navy, U. S. S. *Indiana;* Rowland A. Robbins, president Manhattan Supply Company, New York, N. Y.; Henry B. Shields, draftsman, office of superintending constructor, The William Cramp and Sons' S. and E. B. Co., Philadelphia, Pa.; Hayden Hobart Smith, manager, Marine Department, Thresher Electric Company, Dayton, Ohio; Henry S. Snyder, secretary-treasurer, Bethlehem Steel Company, South Bethlehem, Pa.; Henry C. Watts, Clark H. Woodward, William D. Dimock, R. J. Donovan, Henry Rice, John J. Armory.

Promotion from Associate to Member, 7.—D. H. Cox, assistant naval constructor, U. S. N., Bureau C. and R., Navy Department, Washington, D. C.; Charles James Dougherty, electrical engineer, William Cramp and Sons' S. and E. B. Co., Philadelphia, Pa.; Wilbur F. Powers, leading hull draftsman, Moran Brothers Company, Seattle, Wash.; Richard H. M. Robinson, assistant naval constructor, navy yard, New York; Edson B. Schock, naval architect, 17 State street, New York; James William Lowry Waters, surveyor, American Bureau of Shipping, 66 Beaver street, New York; Walter A. Post.

Promotion from Junior to Member, 4.—Webb R. Ballord, Henry N. Whittelsey, Morris M. Whitaker, Dean Clark.

Juniors, 52.—Harry B. Appleby, draftsman, Department of Yards and Docks, navy yard, Brooklyn, N. Y.; Moro Miller Bordon, engine draftsman, New York Shipbuilding Company, Camden, N. J.; Ross W. Bragg, draftsman, New York Shipbuilding Company, Camden, N. J.; Frank Edwin Craig, draftsman, Neafie and Levy S. and E. B. Co., Philadelphia, Pa.; Frank Harper Crane, superintendent, Theo. Crane's Sons Dry-Docks and Ship Yard, Erie Basin, Brooklyn, N. Y.; Owen Brooks Evans, draftsman, New York Shipbuilding Company, Camden, N. J.; William M. Finkenaur, draftsman, The William Cramp and Sons' S. and E. B. Co., Philadelphia, Pa.; Harry Lamar Grant, with New York Shipbuilding Company, Camden, N. J.; Henry J. Hack, draftsman, New York Shipbuilding Company, Camden, N. J.; Jay D. Hammond, draftsman, Townsend-Downey Shipbuilding Company, Shooters Island, N. Y.; Lyman Foster Hewins, ship draftsman, C. and R. Department, navy yard, Washington, D. C.; Joseph Hunt Holt, draftsman, Marine Department, Midvale Steel Company, Philadelphia; James W. Hussey, draftsman, Scientific Department, New York Shipbuilding Company, Camden, N. J.; Alfred C. Jennings, hull draftsman, Eastern Shipbuilding Company, New London,

Conn.; Martin C. Kindlund, chief hull draftsman, Burlee Dry-Dock Company, Port Richmond, S. I., N. Y.; Luther W. Krout, assistant draftsman, office of superintending constructor, Harlan and Hollingsworth Company, Wilmington, Del.; Charles L. Loos, Jr., hull draftsman, American Shipbuilding Company, Cleveland, Ohio; Alfred E. Luders, draftsman, Tams, Lemoine and Crane, 52 Pine street, New York; William MacHattie, foreman builder, Marine Engine and Machine Company, Harrison, N. J.; Clarence Lee Morrison, assistant calculator, William R. Trigg Company, Richmond, Va.; George Moses Purver, civil engineer, American Bridge Company, 7 West Twenty-second street, New York; Winthrop Melton Rice, draftsman, John N. Robins Company, Erie Basin, Brooklyn, N. Y.; John Alexander Ross, Jr., ship assistant draftsman, office of superintending constructor, Moran Brothers Company, Seattle, Wash.; Paul Alexander Suwald, draftsman, Hull Department, New York Shipbuilding Company, Camden, N. J.; Perry K. Thurston, draftsman, Neafie and Levy S. and E. B. Co., Philadelphia, Pa.; Charles C. Turner, hull draftsman, George Lawley and Sons Corporation, South Boston, Mass.; William Uzelmeier, marine draftsman, New York Shipbuilding Company, Camden, N. J.; Wassily W. Wassilieff, draftsman, L. Powers and Company, Philadelphia, Pa.; John M. Watts, mold loft drawing office, New York Shipbuilding Company, Camden, N. J.; Frank B. Whitaker, draftsman, naval constructor's office, Newport News S. B. and D. D. Co., Newport News, Va.; William W. White, draftsman, electrical department, The Wm. Cramp and Sons' S. and E. B. Co., Philadelphia, Pa.; Alex E. Zetterman, draftsman, George Lawley and Sons Corporation, South Boston, Mass.; Clyde Yeomans, assistant draftsman, C. and R. department, navy yard, New York; Lee R. Stewart, New York Shipbuilding Company, Camden, N. J.; John F. Sullivan, draftsman, navy yard, New York. N. Y.; Les Weir Brownrigg, draftsman, 80 West One Hundred and Thirty-second street, New York; Rowland Dimelow, boat builder, navy yard, Brooklyn, N. Y.; Edward B. Osborn, Croton-on-Hudson, N. Y.; William C. Stauke, draftsman, Western Electric Company, New York, N. Y.; Thomas E. Webb, Jr., draftsman, navy yard, New York; Howard C. Towle, Axel B. Tappan, Joseph S. Potter, Harold W. Patterson, Joseph G. Bradley, Edward Larhan, Joseph G. Purdy, Ernest Fils, Preston S. Stone, Clarence H. Harden, Lee H. Cummings, Henry B. Spear.

The principal feature of the business meeting was the adoption of the council's recommendation contained in its circular of October 24, which had been sent out to each member, whereby the annual dues of members and associates should be $10 per annum, entrance fees the same, and the dues of the junior members should be $5 per annum with initiation fee of $5. The vote of the Society received by mail was, in favor of the recommendation, 548; against the recommendation, 99; total votes cast, 657; total membership qualified to vote, 719. Upon vote, article iii. of the by-laws was amended, so that the dues should be as above stated.

The secretary also reported that the council recommend the re-election of the old officers with the following changes: In the place of the late Rear Admiral William T. Sampson, Mr. Stevenson Taylor as vice-president; Mr. A. P. Niblack and Mr. Henry G. Morse as members of the council in place of Mr. Stevenson Taylor and Mr. Edward Farmer. These recommendations of the council were unanimously adopted and the list of officers is as follows: *President,* Clement A. Griscom; *Vice-Presidents,* Francis T. Bowles, Charles H. Cramp, Frank L. Fernald, Philip Hichborn, Charles H. Loring, George W. Melville, George W. Quintard, Irving M. Scott, Edwin A. Stevens, Stevenson Taylor.

Members and Associate Members of the Council.—W. Irving Babcock, Washington L. Capps, French E. Chadwick, James E. Denton, George W. Dickie, William F. Durand, Nathaniel G. Herreshoff, Ira N. Hollis, William H. Jaques, John C. Kafer, Frank B. King, Frank E. Kirby, Walter M. McFarland, Jacob W. Miller, Henry G. Morse, A. P. Niblack, Lewis Nixon, Cecil H. Peabody, Walter A. Post, Harrington Putnam, Horace See, E. Platt Stratton, David W. Taylor, George E. Weed.

Executive Committee.—Francis T. Bowles, Harrington Putnam, Stevenson Taylor, Lewis Nixon, Edwin A. Stevens; Clement A. Griscom and W. L. Capps, *ex-officio.*

Secretary and Treasurer.—W. L. Capps.

Mr. Griscom when notified of his election said in part:

"On several previous occasions I have remonstrated with you for persisting in selecting a comparative layman for this high office, but I have none the less been keenly sensible of the honor conferred upon me and beg to thank you for it. At the time of the foundation of this Society, in 1893, the American mercantile marine was still struggling against adverse conditions, largely due to national apathy in all matters affecting our maritime prestige. It is to be hoped that our commercial necessities and a quickened public sentiment may serve as potential influences, until the mercantile marine of the United States may again attain that supremacy among the fleets of the world which was once the source of our greatest national pride. While we may well be proud of the development of our navy, we must not forget that the foundation of true naval strength lies in large merchant fleets, from which a war fleet can be recruited in times both of peace and war."

FIRST TECHNICAL SESSION.

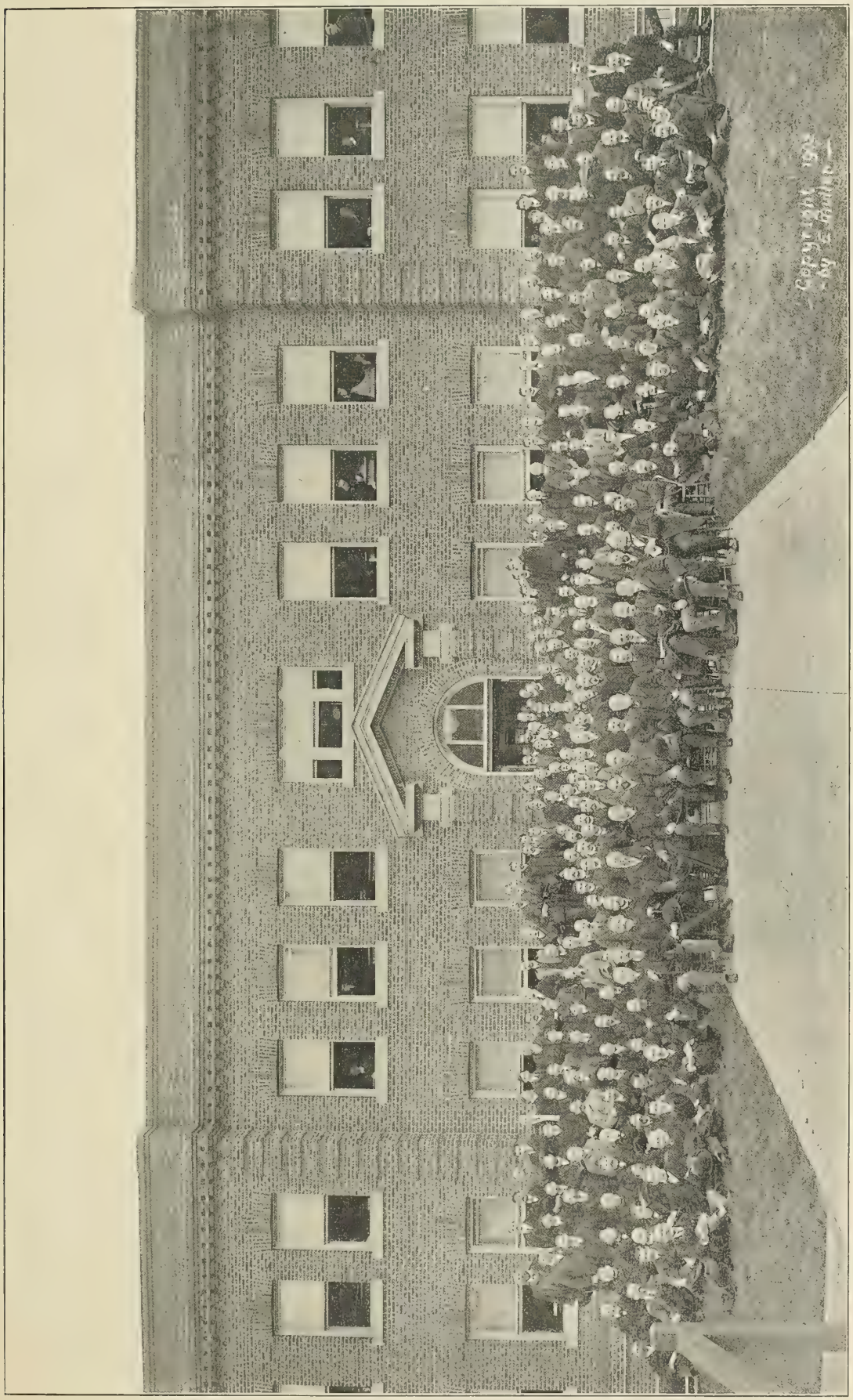
The technical session was opened with President Griscom in the chair. In the absence of the author the first paper on the programme was read by Secretary Capps.

TECHNICAL TRAINING FOR SHIPBUILDERS.

BY HENRY S. PRICHETT, LL.D.

Abstract.

This paper deals with the general problem of professional education for the shipbuilder, and in particular with the course of instruction offered at the Massachusetts Institute of Technology. The author discusses the relation between the general groundwork for such a course and the professional studies, and illustrates his points by reference to the course of study at the institution referred to.



GROUP OF MEMBERS OF THE SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS, TAKEN BEFORE THE ADMINISTRATION BUILDING, NEW YORK SHIPBUILDING COMPANY, CAMDEN, N. J., ON NOVEMBER 22, 1902.

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DISCUSSION.

PROFESSOR CECIL H. PEABODY: My attention has been called to the fact that in rehearsing the several things proposed undue attention seems to have been given to submarine boats and automobile torpedoes. The fault of this, if it exists, lies with myself; I did not appreciate that they were thrown into the apparent prominence which is given to them here. They are well recognized to be of secondary, though great, importance. This comes out especially in the schedule for the graduate year. The first two years, junior and senior, are now in operation and will be changed but little, except in such manner as may be required by the growth of any live school. The first two years are intended to cover, by lectures in naval architecture, substantially all of the accepted theoretical work, and perhaps it is not wise to go further into that.

PROFESSOR W. V. HOVGAARD: The work is in three sections. The first section is the real design work. That is laid out on very much the same lines that it was at the Naval College in Greenwich, but with this difference: In Greenwich we had two students on one design, while we give each student here his own independent design. The second section consists in a series of lectures, which begin with the history of the development of warships. It gives a history, both for coasters and for other important types of warships, and the relation of how the different steps in the development have been brought about. After the historical part, the next lectures will be on the theory of naval design. They are to contain a discussion of the general principles, for choosing and settling upon the elements of a design. The last part of the lectures will consist in the discussion of the structural arrangement of warships: comparing American, English, and French warships, in a general way. The lectures will be accompanied by a great number of compilations of data which we hope will be instructive and useful to the students hereafter. These lectures, as well as the structural lectures, are lined out much on the plan of the well-known book of M. Comeaux. The third section is to consist of visits to the shipyard. Thus I hope to give them a certain aptitude for the interpretation of working drawings, which I think cannot fail to be of value to them later on in life.

REAR ADMIRAL FRANCIS T. BOWLES: Without discussing the means or the methods of instruction set forth in this paper, I want to accept Dr. Peabody's apology for the undue prominence given to the submarine boat. That was hardly necessary, because the study of submarine boats, from a student's point of view, is probably one of the most intricate in the study of naval architecture. What this paper really intends to present is this: The Government of the United States, having been in the habit of sending its students abroad for instruction, has now concluded to instruct them in this country; and this paper is a notice to the profession of that fact, and also that we are quite willing to instruct other people.

NAVAL CONSTRUCTOR PAXTON: I have had special opportunity for following the work of young naval students, and I want to emphasize a little as to the practical work which they are doing, and bring out that each week these students perform manual labor in the shops—the juniors; and the seniors each week study shop management and shop administration. Thus we put them in touch with the workingmen, and they can understand the feelings of a good mechanic and know how to sympathize with him in his work—which is the work these students must direct in the future.

MR. W. G. FORBES: This paper is of very great interest to me, being on the New Jersey State Board of Education, and I want to emphasize one or two points which I think are touched upon here too lightly. In the delightful remarks of our president at the opening of the meeting to-day, he spoke about the facts of American shipbuilding. Now, there is nothing that will bring about American shipbuilding so much as having technical men in charge of the shops, in positions which to-day are always handed over to men of good mental ability, but who lack that technical training which is spoken of in this paper. Within this room there is a gentleman who took charge of my shop as its foreman. He was just such a technically trained man. It was perfectly marvellous, the difference that that young man made in that shop in a very short time. Now, it is to that style of man that we must look, who will assist us in making our merchant marine what it should be—the leading merchant marine of the world. Take a map of the world, and then take a blue lead pencil and mark the lines of great sailing vessels, and then with a red lead pencil mark the lines of those great steamships. It will look like the chart of the human body, with veins and arteries; but they almost all terminate in that little heart of a country—England. Let us impress upon those we come in contact with the value of this technical training, so that those lines will run to our country.

MR. W. H. JAQUES: I think perhaps this Society will accept the recognition of the influence of technical training which has permitted and fitted this country to take care of itself. I think there is no other member of this Society who will admit it more than Admiral Bowles, in the recognition of the foreign training which has permitted us and admitted us to the first place in the world of naval administration.

MR. STEVENSON TAYLOR: The necessity for this technical training is being shown in the institution of which I had the honor of being president, and the success with which the students who graduate annually from that institution obtain good positions. Unfortunately, none of you gentlemen can come to that institution because you are all too well off, as it was founded by the beneficence of one of the class so well spoken of in this paper, a shipbuilder, William H. West.

NAVAL CONSTRUCTOR WILLIAM H. VARNEY: I wish to add one thing to what has been said here. Some of the older members of this Society and some of our naval constructors recollect the day when our American wooden ships were the best ships there were in the world. We lost that prestige, but we are in hope that we will presently regain it. We lost it because foreign countries made a more technical study of shipbuilding than we did. But we are now regaining it, by taking advantage of what they have done, and then adding our American inventive genius to it, which enables us to go forward to success.

PROGRESSIVE TRIALS OF THE SCREW FERRYBOAT EDGEWATER.

BY EDWIN A. STEVENS, VICE-PRESIDENT, AND CHARLES P. PAULDING, JR.

Abstract.

The *Edgewater* is a screw ferryboat of the usual type with a screw at bow and stern.

This paper presents the results of three sets of trials as follows: (1) with one screw astern; (2) with the same screw ahead; (3) with both screws. The dimensions and characteristics of the boat are given together with the complete data taken on the various tests, and the results derived from this data are presented in graphical form. The speed-revolution curves given were worked up by the method described in a paper on "Tidal Corrections," which forms part of vol. vii. of the transactions of the Society of N. A. and M. E. The necessary descriptions regarding the method of reduction of the data are given, so that the entire work may be checked or such other use may be made of the data as might be desired. Naturally the results showed the best propulsive efficiency for a single screw working at the stern, next for both screws, and the poorest for the single screw working at the bow.

DISCUSSION.

MR. F. L. DU BOSQUE: This is a very interesting paper, particularly to those interested in ferryboat designs. It is very gratifying to see the low admiralty efficiency of this boat. I do not like to say that this boat seems to run on a ferry which permits of that low efficiency. Every trade has certain limitations which require certain amounts of data in different directions, and it seems very interesting, as a contribution to this paper, if the author could exclude those calculations in the discussion. It is well recognized that having a certain form of hull, which is limited in proportion to the ferry on which the boat is going to run, that very little gain can be obtained excepting by some improvement in propulsion. In a paper read before the Society in 1896, certain lines were suggested, I think, by which that gain could be obtained. As you are aware, these boats have a screw at each end, and the system is inefficient. In the case of the *Edgewater,* it appears that about 25 per cent. more power is required to run that boat at her usual speed with two screws in operation than with one screw pushing at the stern. It would seem quite desirable to save that 25 per cent. if possible. At the trial described on the ferryboat *Cincinnati,* experiments were made to try and overcome that loss of efficiency of the power of the screw. In the case of the *Cincinnati* it amounted to about 16 per cent. Since then a system has been put into effect which practically does overcome that loss. I would describe it by saying that it is simply by designing a wheel that has a very limited backing power. Some of the ferryboats around in the harbor are equipped with wheels very similar to those used on the fast torpedo boats, where the blades incline to a very considerable extent. It has been found that this type of wheel requires less power to propel with two screws in operation than it does with one screw in the stern.

MR. STEVENS: I wanted especially in preparing this paper to avoid any question of comparing different boats, because the custom on different lines cannot be compared. Taking the *Edgewater* and the *Cincinnati,* I may say that in the case of the *Edgewater* it was desired to obtain the speed because the company was unable to afford a large number of boats. Therefore, speed in crossing the river was the decided consideration; the team travel being comparatively light over that route, and therefore the load at the end of the boat comparatively small. These conditions were exactly reversed on the Cortlandt street ferry, where the *Cincinnati* was put on. She was designed with a very much harder shape and hull—a rather difficult design hull. At low speed, taking into consideration the fact that the boats were run by steam thirty per cent. of their actual time, the amount of saving was comparatively small. These facts are only given because in a case were a designer to go from first experience in these boats to any high-speed boat, these figures would become of some value. But I want to disavow any intention of having these figures taken at all as criticising other designs. What I wish to say is in regard to the figures quoted by Mr. Du Bosque, of 25 per cent. of power in using two screws over one screw; that is approximately the figure I have arrived at. The justification for the double screw arises from the fact that if you take the power necessary to drive a boat with a single screw ahead, the mean of that and the power for the single screw astern will be found higher than the power used for two screws. Of course, besides that there comes the fact of maintenance. The bow screw gives more handiness. stopping power, and control, and especially the saving of time in entering and leaving slips, allowing the boats to maintain their speed very much farther into a slip. The use of a screw with full backing power has, I understand, been followed with very decided gain in the case of the Pennsylvania ferryboats. I would call attention to the fact that most of the boats that I have had anything to do with previously have had screws designed to be equally efficient in both directions. Judging from these trials, I would consider that that which is only a small departure in the direction indicated by Mr. Du Bosque has given the result. Probably better result could be obtained with the wheel which he suggests, more of the Thornycroft type.

MR. DU BOSQUE: I had occasion to compare the screws of the *Edgewater* with a screw that we happened to have on the boat, and the result appears like this: The *Edgewater* now requires 520 horse power to propel the boat with 14 1-2 per cent. slip. In the comparison of the effective thrust it is necessary that the slip should be identical. A wheel with a similar effective thrust, 14 1-2 per cent. slip, will be propelled on the Thornycroft wheel with a saving of 65 horse power, or 18 per cent. I found that the admiralty coefficiency of the *Edgewater* was raised to 104 by the use of this wheel, which I consider to be extremely high for a ferryboat.

POSSIBLE AND FUTURE DEVELOPMENTS IN THE USE OF ELECTRICITY ON BOARD SHIPS.

BY F. O. BLACKWELL.

Abstract.

A comprehensive discussion of the different features of electrical machinery on shipboard is given by the

author under the three general subjects, substitution of steam turbine for reciprocating engines for driving electric generators, the use of alternating-current generators and motors of continuous-current apparatus, and the operation of all auxiliary machinery on ships by electric motors. Under the first heading the author believes that the steam turbine cannot be regarded as a general substitute for the reciprocating engine, as its speed is too high for direct connection to most machinery or for safe use of gearing; for the electrical drive, however, it is ideal. Compared with the reciprocating engines in slow-speed generators now in use, a turbine plant could be installed which would have but one-quarter the weight and take up but one-tenth the space. The efficiency is very high for the turbine at both full and partial loads, namely: about 20 pounds of steam per kilowatt hour at full load and 22 pounds at one-half load, in comparison with 30 to 50 pounds for reciprocating compound engines running at full load and 40 to 65 pounds at one-half load. Alternating-current systems, generators, motors, and wiring are discussed both in the matter of design and in application. The author believes that all auxiliaries, including the feed pump, circulating and air pump, should be driven by motors, thereby greatly reducing the steam consumption. A table is given showing the number of auxiliaries, with their rated and ordinary horse power, to be installed on the battleships *Connecticut* and *Louisiana,* and a plan is submitted whereby all this machinery might be driven by electricity. He would divide the electric power into two separate plants, each to contain two units of 300 Kw. each. The present plans call for two separate power plants each to contain four 100 Kw. units. The power required for lighting, searchlights, driving the turrets, steering engines, anchor windlass, hoists, blowers, and pumps is taken up in each individual case. In concluding the author would recommend for transmitting power the polyphase current, and the induction motor for constant speed, and that the steam turbine should be used for driving the generators.

DISCUSSION.

Admiral Bowles: It is a most interesting and timely paper, and the author is most certainly entitled to the thanks of the Society for the very clear manner in which his points have been made. I am entirely in favor of the extended use of all electrical auxiliaries on shipboard, and in the designs of the new battleships, the *Connecticut* and the *Louisiana,* all of the auxiliaries under my control are operated by electricity except the steering apparatus and the windlass. The Navy Department has begun the introduction of electrical steering gear, and has taken up the matter cautiously, feeling that the systems at present used are not entirely satisfactory. The point made by the author of the paper in regard to centrifugal pumps is an interesting one, and I believe in the *Connecticut* and in the *Louisiana* the first use is being made of the centrifugal pump for minor auxiliary purposes. I feel that there ought to be some doubt expressed as to the very extended use of centrifugal pumps, recommended by the author of the paper, because any person who has had to operate centrifugal pumps under circumstances where I may say life and death depended upon its operation is familiar with cases where the cussed thing wouldn't work, and nobody could find out what was the matter with it. I may also say that there are various influences which prevent the extension of the use of electricity for auxiliaries on shipboard. The chief engineer, for instance, is not generally in favor of electrical auxiliaries, because he cannot turn on the juice without asking permission, which he can readily do when he uses his own steam. That seems a trivial thing, but it is really of very great importance.

Mr. J. G. Winship: On the subject of auxiliaries, I have had some experience with the electrician or the designers of electrical machinery, and I have always found that the electricians preferred to use steam power for all their auxiliaries. We are in a position now to state that the centrifugal pump is going to be used more than it was. I have been quite surprised lately—and I have had considerable experience with pumps—in one of our factories to find that they were so far ahead with the centrifugal pump. For instance, the other day I asked for an estimate, or some data on a centrifugal fire pump, and with your permission I will read you the letter that I received:

"Referring to your recent inquiry in regard to fire pumps to handle approximately 3,000 gallons of water against a maximum pressure of 160 pounds, we would offer —— turbine pump, running at 450 revolutions per minute at a maximum pressure of 160 pounds, and 350 revolutions for a minimum of 100 pounds pressure."

I want to say, respecting the experience with centrifugal pumps, that we will not even stop at the air pump; some of the experiments have been made in our work where the pump used was an air pump, and it was quite a success. I think you will find that as we go along with the centrifugal pumps that they will be used more than ever.

Naval Constructor Varney: Some years ago, while superintending a small vessel, I ran into a little difficulty in reference to ventilating that vessel. I conceived the idea that electricity would be very beneficial and save a great deal of room. It would save long and large air ducts, by substituting a number of small electrical fans. I immediately ran against a snag, for I found that the electrical power being controlled by another department, they raised objection to it. That has been a great drawback in the substitution of electricity, as I have found. I believe that electricity could be used, and should be used largely in ventilating ships, and in other places, as far as possible. I see no difficulty in the ventilating system, because it would do away with these large air ducts, and would certainly save a great many steam pipes.

Lieutenant-Commander William P. White: Hardly enough importance seems to have been given to the matter of the turbine drive for main dynamos. The control of the compound engine that is installed on board ship is simple enough, but it is not simple in regard to the saving of steam. If a vessel is going into action, where the work on the motors to drive the ammunition hoists is going to be very intermittent, it will need at some times a great deal of steam and at other times very little, and it will be necessary to have all the dynamos, or the majority of them, running, and it will be just at that time when the call upon the engineer to drive his engines as fast as possible and use as much

steam as possible will take place. Now, if we can do something to limit the use of steam in driving the dynamos, we will make one step in advance in regard to the speed of the engine. The use of electricity in various parts of the ship, as far as I know, is not opposed by any officer or any set of officers, or by any bureau. It is simply a question of who controls the building of the motors and installing them. The matter of the method of using the current can be carried on with the present installation in regard to lighting, but of course will have to be changed in regard to the power. It will be simply a question of changing the wiring. But in designing the ship, in reference to the electric wiring, or if the electric wiring is going to be very extensively used, some consideration must be made for carrying the wires from the dynamo to the different parts of the ship. It is customary in some ships to carry them through the compartments that lie outboard and below the protected deck. It is so done in the open wiring in the *Kentucky* and in the *Kearsarge,* I believe, where they have the three-wire system. If those compartments should accidentally become flooded, or even if there was a slight collision, it would throw the entire electrical plant out of order on one side of the ship. We ought to make an allowance for that, by making a complete system on different sides of the ship. But it is not desirable to run the wires or to run the piping in the passageway immediately behind the armor, because any injuries to the armor will break up our electrical connection. For that reason there should be some arrangement made for carrying the pipes fore and aft of the amidship line. That could doubtless be done if the original design of the vessel was arranged in that way.

MR. WHEELER: In regard to this question of economy, I wish to say one thing: The reciprocating engine gets a pretty black eye in the United States Navy when it drives generators, and this arises from a condition that I do not think is generally known. The navy demands an engine that is practically one-third larger than is necessary. That is very detrimental to the economy sought. It also demands that that engine shall run under conditions of low pressures of steam and high pressures of steam.

The author of this paper did not speak much about the weights. Now, that and the application of electrical motors for the machinery is a very important matter on naval vessels. I had occasion recently to design a high-grade vacuum pump for use with steam turbines where they expect to get 28 1-2 inches. It was necessary to elaborate somewhat, but I found that the weight was more than double and the floor space two or three times as much as would be required by a reciprocating air pump. Speaking of the *Minneapolis* trial trips, I hardly think it is fair to quote, because it was a notorious fact that the auxiliaries of that ship were in a very bad condition and the selection of many of them would not be tolerated to-day. For instance, the dynamo engines were in such bad condition that upon repairing them they used exactly one-half the steam, and many of the auxiliaries were entirely ill-proportioned for their work for the best economy. In fact, there were many of the auxiliaries that could have been compounded with very good result. There is one thing that is going to be of great advantage to the steam turbine, and that is the doing away with oil. If we can adopt that motor for auxiliaries, pumps and otherwise, it will be a grand thing to do, although we are adapting ourselves to-day to run without oil. We ought to place the economy of these turbines a little better than they promise. I think the future for the steam turbine is very promising, especially in connection with rapid-running machinery like centrifugals.

NAVAL CONSTRUCTOR VARNEY: In the use of a centrifugal pump, the efficiency of the pump is much benefited by having it as low down as possible, even if it is running in the water itself. May I ask the author of the paper how that will work with an electrical motor near the water, where it is liable to become short-circuited or destroyed? I would like to know what the author of the paper thinks about that, and whether he has considered that subject.

MR. BLACKWELL: Of course motors are used very extensively for mining and for sunken pumps, which are liable to be submerged quite often. Such pumps are made entirely enclosed. However, we have made them so that with 50 or 100 pounds steam pressure they have worked without leaking. The only difficulty with them is that the heat radiated in them must be carried off, to keep the motor within safe lines. If it was entirely under water there would be no trouble with it; but in a sunken pump, where you are running part of the time in water, we have the motor of the pump water-jacketed, so that the water passes around the motor and goes out in the stand-pipe, and that keeps the motor cool and permits the use of an entirely enclosed motor.

SECOND TECHNICAL SESSION.

The session was opened at two o'clock with Admiral Bowles in the chair, and, in the absence of the author, the following paper was read in abstract by the secretary:

PRELIMINARY OFFICIAL TRIAL OF THE UNITED STATES BATTLESHIP MAINE.

BY ASST. NAVAL CONSTRUCTOR J. W. POWELL, MEMBER.

Abstract.

This paper contains the usual data of trials conducted by the Government, and also takes up the question of general hull ventilation. Thermometers were placed in all parts of the vessel and records made of the rise in temperature when under full power. Some interesting photographs, showing the wave forms, are appended, and an outline of the wave profile at 18 and 17 knots speed is given. In the reversing test it took but 9 seconds from full speed to stop the engines, and 5½ seconds from "stop" to "astern." From "stop" to "full speed astern," 57½ seconds. The third feature of the test consisted in the turning experiments, which showed very valuable results. The final test of the trial was made on the anchor windlass and anchor handling gear, which consisted in dropping the anchors in deep water, the starboard bower to 90 fathoms and the port bower to 60 fathoms, and hauling them both together. On the four-hour official trial the true speed for the first run was 17.772 knots, and for the second run 18.228 knots.

In the absence of the author the next paper was read by Mr. A. M. Main.

THE WATER-TUBE BOILER IN THE MERCHANT MARINE.

BY WILLIAM A. FAIRBURN, MEMBER.

Abstract.

This paper opens with a brief historical presentation of the evolution of the water-tube boiler from the earliest types to those of the present day. The author then takes up the discussion of features to be considered in the design of a water-tube boiler suitable for merchant vessels. These in his opinion may be stated under the following heads:

1. All tubes should be absolutely straight and of uniform length. They should be of seamless drawn steel or nickel steel, very uniform in quality, and as near non-corrosive as is possible, with a ratio of length to diameter not exceeding 30 diameters. These tubes should be submerged and be placed on an angle of about 10 degrees from the horizontal. The boiler should be sectional, with front and back headers, or a compound front header with circulating tubes within the generating tubes. The tubes should be not less than three inches diameter, more preferred, and have a thickness varying from No. 5 to No. 8 B.W.G., according to size and location.

2. The steam drum should be placed at the front of the boiler with its center square with the tubes. The water level should be at the center or a little below the center of the drum. The drum should be not smaller than 45 inches diameter when space permits. If back headers are fitted, the steam discharge to the drum should be horizontal and connect to the drum at the water level. The interior of the drum must be made accessible. No part of the drum should be exposed to the hot gases.

3. The headers should be of wrought steel. No cast metal should enter into the construction of any pressure part of the boiler. The proportioning of the relative areas of the headers, uptake and down-cast, determines the capacity of the boiler and regulates the circulation.

4. The water circulation must be active and positive, and follow a defined path. The more rapid the circulation of water over the heating surface, the greater the evaporation.

5. The furnace or combustion chamber should be high, at least three feet, so as to thoroughly mix the gases before coming in contact with the heating surface.

6. All parts of the boiler exposed to the gases or pressure, particularly the exterior and interior of tubes, should be accessible for cleaning and repairs. It is necessary to keep the outside of tubes free from soot and fine ashes, the latter being especially destructive when moisture, such as is obtained from an attempt to clean from the outside with a steam jet, is present. A boiler composed of tubes that can be drawn from the front for examination possesses great merit. Expanded joints are preferable in many ways, but the necessity of keeping a boiler clean is of vital importance.

7. The boiler should be easily drained without resorting to siphoning or the withdrawal of elements or individual tubes.

8. The headers should be of corrugated form, the tubes being staggered, with no straight paths for gases between the same.

9. There should be a mud drum or receptacle arranged for the reception by gravity of solid foreign matter separated from the feed water.

10. The path of the gases leaving the furnace or combustion chamber should be approximately square to the tubes, and such that all the heat possible is abstracted from said gases before they enter the uptake. Efficient baffling can only be determined by experiment, and the nature and extent of the baffling will vary for the various rates of combustion. Proper baffling with reasonably good firing will eliminate the criticism of high stack temperature.

11. The air supply to the fires and furnace must be ample, but not excessive. Air supplied under pressure over the fires from all four sides of the boiler may be found desirable. Distance between fire bars is of great importance. Hot-air supply and induced draft may be found exceedingly efficient for water-tube boilers.

12. The boiler should never be placed with steam drums forward and aft, and tubes athwartships, in any ocean-going vessel, or in any vessel navigating rough waters.

13. The boiler should be capable of being built in any well-equipped boiler shop. The parts should be simple and of uniform construction, with as few different parts as possible. A large number of spare parts to be constantly carried at sea is undesirable. The boiler should be built so that it can be readily repaired by the vessel's own staff, no extra skilled labor being necessary.

14. The boiler should have a large ratio of power to unit of floor space and volume.

15. The boiler must stand forcing and maintained severe service.

16. The casings should be air-tight, built of heavier material than is usually used, and well insulated throughout in a manner that will stand the test of time.

17. Dry steam must be generated and the steam should have free and unobstructed escape to a steam dome placed at the center of the drum, from which the dry pipe leads to the main steam pipe. No separators or reducing valves should be permitted having for their object the drying of steam.

18. The feed arrangements should be simple and require no elaborate automatic apparatus.

19. The steam should be generated at a pressure equal to the working pressure of the engines. The boiler must be suitable for high pressure.

20. No screwed connections should be exposed to the gases.

21. Economizers placed in the uptakes are very efficient, but their inaccessibility and great cost of upkeep do not warrant their adoption. The feed water must, however, be injected into the boiler at a very high temperature.

22. The use of induced draft and air heaters, permitting a low stack temperature, making the installation independent of climatic conditions and causing a cool fire room, is considered favorable for a marine water-tube boiler installation.

23. The pressure on feed lines should not exceed the boiler pressure, and the feed system should be such that the amount of air in water is reduced to a minimum.

24. Mechanical stokers or oil fuel will probably be

used, and great gains result from better combustion, more regular uniform heat, constant steam pressure, and the prevention of loss of heat caused by frequent opening of fire doors.

25. The boiler must have absolute freedom for expansion.

26. The boiler must respond quickly to any sudden or unusual demand for steam and carry a steady water level.

27. The weight of the boiler should show approximately the same relative advantage over the weight of Scotch boilers as the water-tube boilers discussed in this paper. The parts should be light and easy to handle.

28. The thermal efficiency of the boiler must be equal or superior to that of any fire-tube boiler tested by the same unprejudiced engineer under exactly similar conditions.

29. The boiler must be capable of showing good results when burning inferior coal.

30. A tube should be renewed or plugged without removing any other tube or pressure part, or cooling down the boiler, other than by blowing off the pressure. The component parts should be independent of one another, so that the removal and repairs of one part do not disturb other parts.

31. Sufficient water should be carried in the steam drum to give the boiler a period of about twenty minutes before the water in said drum is evaporated, provided the feed is shut off and the boiler continues steaming easy under the usual natural draft conditions, burning about fifteen pounds of coal per square foot of grate surface per hour.

32. The steam space in cubic feet should be about equivalent to the grate surface in square feet.

33. The ratio of heating surface to grate surface should be not more than 40 to 1, and possibly less for natural draft conditions.

34. Suitability for rapidly raising steam.

35. Must be capable of being built in large units, and if worked entirely from the front, or front and back, side battery construction may prove advantageous.

36. Should consist entirely of cylindrical components with spherical ends, all parts being self-sustaining without staying.

37. The cost should be no more than that of a Scotch boiler.

The author then considers in some detail various modern types of boilers relative to the various requirements as laid down, and concludes that the successful water-tube boiler of the future that will ultimately displace the Scotch boiler for deep-sea merchant work will be designed upon experience gleaned from the working of such boilers as the Niclausse and Babcock and Wilcox.

In connection with the discussion the various advantages and disadvantages of these types are presented in detail, and comparisons are made between the straight large-tube types and the cylindrical fire-tube type.

The subject of mechanical stokers is also discussed in its relation to the marine field, and its various advantages and disadvantages are pointed out. Similarly the subject of oil fuel is taken up and discussed with particular reference to its use in water-tube boilers. The paper is accompanied by a large number of plates illustrating various types of boilers, and in particular the Niclausse, and certain types of mechanical stokers.

DISCUSSION.

THE CHAIRMAN: Gentlemen, you are no doubt ready to support the Chair in congratulating the reader on the excellent abstract he has presented of this compendious paper. It also directs your attention to the excellent theories of 37 commandments to be followed by builders of water-tube boilers. No doubt the conclusion stated in the paper upon the various points will give rise to a very interesting discussion.

MR. A. H. RAYNAL: I have listened to the paper by Mr. Fairburn with great pleasure, and find it of much interest. The author has gone over the ground of the history of the water-tube boiler in a very admirable way, and has compiled data which are certainly of value. There can be no graver question before the naval architect or marine engineer than the determination of the proper installation of boiler power. A mistake in the selection of the right type of boiler has been fatal in many cases. The experience of the British navy, recently brought so prominently before the engineering world, shows the importance of this question. While the author carefully quotes a certain classification or grouping of types arranged by Bertin, although differing materially from those by other writers, he couples the Babcock and Wilcox and the Niclausse boilers so closely and so frequently in his paper that when one reaches the end of the paper there may be doubt in the mind of the reader which is which, and whether there is much, if any, difference between these two types; or if there is any, that it is of so small an amount as to be of very little importance. It is this feature of the paper to which, as an engineer somewhat acquainted with the history and the development of the water-tube boiler in the United States, I object. The statement is made: "The only large installations made in American steamships have been branded failures, Babcock and Wilcox boilers being condemned in one vessel and Belleville boilers in the other two." That there were two failures of the Belleville boilers is an accepted fact and need not be discussed here. The failure of the Babcock and Wilcox boilers, however, I would emphatically deny and would challenge the writer of the paper to bring proof of. It is true the Babcock and Wilcox boilers were taken out of the *Grande Duchesse,* but under what circumstances? It would have been worth a good deal to the engineering profession had the conditions been ventilated in court and the reason found why a battery of boilers that was installed to develop 5,600 H.P. and actually developed over 8,000 H.P. continuously from New York to Savannah should have been condemned. Their true history forms one of the grandest proofs of the safety and efficiency of the Babcock and Wilcox boiler. In paragraph 13, on page 4, the condition of repair by the vessel's own staff without extra skilled labor is certainly not fulfilled by the Niclausse boiler, while for all reasonable repairs it holds good with the Babcock and Wilcox boiler. A tube that is rolled into place can be readily cut out and replaced by common laborers, and this has even been done by firemen of the ship. I know of cases where the boilers of farm engines have been retubed by green

hands fresh from the farm, and I am even aware of cases where boilers were retubed by prison laborers who never had been inside of a boiler or had a boiler-maker's tool in their hands before. Paragraph 15 is a very important condition, referring to the absolute necessity for a boiler to be able to "stand forcing." With the little experience had with Niclausse boilers in warships so far, it may readily be asserted that the Niclausse boiler cannot stand forcing. Whenever attempts have been made to force the boilers they have become leaky and the economy has been impaired to such an extent as to cause almost a total failure. On the other hand, repeated experience with the Babcock and Wilcox boiler in our navy has proven that this type of boiler can stand forcing for a long time without any detrimental results. I have shown enough, I think, to prove that there is considerable difference between the Babcock and Wilcox and Niclausse boilers; enough to warrant me in asserting that they should not be classed together; enough to show that they do not belong to the same type. On page 14 the author speaks of the preference in the installation of boilers in favor of the Belleville and Niclausse boilers, and concludes that "the figures for the Babcock and Wilcox boilers are not as good as these boilers usually show." This assertion falls to the ground completely when it is considered that the Niclausse boilers cannot be placed athwartships on account of the roll of the ship. I assert that this question of installation is entirely one of skill of the designer, and it is a fallacy to so closely pack together boilers that their inspection and cleaning are jeopardized.

On page 24, paragraph 4, the author refers to the economy of water-tube boilers in general, and makes the statement that "the water-tube boiler is not at present as economical in continuous steaming as the best type of fire-tube boilers." I would emphatically deny the accuracy of this statement. Water-tube boilers have been proved to be economical, and in this respect they have only failed when improper baffling was arranged in them. We have definite proof that not only are the water-tube boilers as good in economy, when properly designed, but that they even are more economical than Scotch boilers. One of the most convincing proofs of this statement can be found from the data of the tests of the boiler for the U. S. S. *Cincinnati.* Not only was this boiler eminently economical in the trials ashore, but the almost phenomenal results of this ship on her late cruise have demonstrated that the same results are obtainable afloat as well as ashore, even when proper firing is handicapped by a complement of green firemen and under the severe exigencies of actual service requiring the ship to be ready for any emergency at a moment's notice. On this subject I would like to submit a few figures that I have not with me at the present time, but with your permission, Mr. Chairman, will submit later in writing for record.

The author's statement that "the boilers of Niclausse type are splendidly designed to take care of uneven expansion of tubes" is certainly correct; but it must be added in this connection that in their desire to emphasize this point, the designers have sacrificed more important points. Besides, it is a positive fact that this loudly-heralded disadvantage of water-tube boilers, that have tubes held at both ends, has caused no serious inconvenience in actual practice. If this type of boiler were unable to take care of the expansion of tubes the Babcock and Wilcox boiler could not exist to-day, instead of being a living example, nearly forty years of age, of the misconception and error of this alleged serious fatality.

The section on inclination of tubes and the relative efficiency of straight and staggered rows of tubes refer to the often-quoted experiments of Watt. Now, while Mr. Watt could lay down a great many essentials of how a water-tube boiler should be constructed, the fact remains that he never succeeded himself in building one that amounted to much; and the author referring in this paragraph to the advantage of staggered tubes against rows, showing on page 12 very clearly a perfect arrangement of staggering of tubes in Fig. 1, omits to state the fact that this method of staggering is not pursued in the construction of the Niclausse boiler of the present day. The tubes are not completely staggered, but leave almost a straight way between two adjoining elements, so that their claim of 18 per cent. saving would probably be reduced to 9 per cent., as the Niclausse boiler is only, if I may use the term, a half-staggered boiler. When the author speaks of the Babcock and Wilcox boiler and says: "Its defects can be practically summed up in one clause—difficulty in keeping clean," he gives the greatest possible praise to that type of boiler, for if this is the only objection that can be raised against the Babcock and Wilcox boiler, and its very existence to this day disproves the truth of this statement, there is nothing left but the conclusion that the Babcock and Wilcox boiler is one very close to perfection.

THE CHAIRMAN: Fortunately for the management of the Society, Mr. Raynal's train was late and he evidently had plenty of time coming here to read the paper through and prepare this very able discussion that he has presented to us. The Chair sees other gentlemen present who can doubtless add to the interest of this discussion.

MR. M. T. MOORE: I would like to ask if any one knows why the Belleville boilers were taken out of the steamships *Northwest* and *Northland.*

MR. R. L. NEWMAN: Being one of those unfortunately connected with the installation of that plant, I will say that the Belleville boilers were removed because of faulty circulation. We found that the second row of tubes would continually burst on the top side. The circulation was so defective that a steam blister would form on the tube and the top would split through local heating. That was the plain cause of those boilers coming out of those steamships. There is just one word which I would like to say in reference to Mr. Raynal's remarks. I remember some eight years ago reading Mr. MacFarland's paper on the subject with a great deal of interest, and investigating the tube boiler, so much so that I thought that boiler was the only boiler extant. It is true that the first cost of construction is somewhat expensive. It possesses one very great advantage, and that is the ability to remove one of the tubes and replace it, which I think no other water-tube boiler possesses to-day. I do not think it is a good boiler for forcing, however. For the mercantile marine, it strikes me that the boiler has one very good feature, and that is that it should be able to supply dry steam.

MEMBER: Mr. Moore was asking the question why the Belleville boilers were taken out of the *Northland* and the *Northwest*. I would like to ask why, since these boats have been supplied with the Scotch boilers, they have not been as regular in their trips as in previous years. The *Northwest*, as I understand, has never made her time yet.

MR. W. IRVING BABCOCK: I have just returned to-day from the Great Lakes, and while there I met some friends on Lake Superior, and asked them this same question. I was given to understand that the Scotch boilers were not giving the power that they had expected to derive from them. Now, probably that may be due to the coal they use, but it is true that they are not able to run on the schedule they were intended to do.

MR. MOORE: I asked the question because I wanted to see if anybody thought as I did, and now that the question has been answered I see that they did think as I did. I made a trip three years ago from Buffalo to Duluth on either the *Northwest* or the *Northland*, and at nearly every port we stopped at we changed elements and firemen. When we got to Duluth they hoisted out about 12 or 15 elements—as they called them—and they were all split exactly as Mr. Newman has stated. The chief engineer told me that the only way that he could keep firemen when he left Buffalo was to give them knockout drops. Those tubes looked as if they were split open while red hot. They were perfectly clean inside and out. Those steamships at that time did not make their time by any means, and I think it would be impossible for them to do so.

MR. NEWMAN: I think on the lake that one season the Belleville boiler ran very successfully, and the season when it did run so successfully I understand they imported Spanish firemen and the engineer was a Scotchman. The trouble usually is, you see, that the firemen that they get up there on the lakes are a very inferior type of men. The Spanish firemen on the vessel on this occasion were not able to speak English, and they simply obeyed orders, they fired regularly and they fed regularly, and perhaps that is why the thing worked so successfully that season. One great trouble with the native firemen that they get up on the lakes is that they think they know all about firing and they won't take orders. Perhaps that is one reason why they have condemned boilers of the Belleville type in this country.

MR. JAMES G. WINSHIP: Now, I can go back to the time when the naval vessel was filled full of boilers and third assistant engineers. But I must say that at that time the ship generally got there. The late transactions of the United States navy developed the fact that one ship out of the fleet made a trip of ten or fifteen thousand miles with steam up all the time and was ready for action. Some of the other ships, as the records show, were not in action and couldn't get in action. Now, the point is, if the Scotch boiler and the water-tube boiler can get a ship in action, then that is the kind of a boiler they want. I used to be in the transport service. The army had charge of us. If our ships were not ready, we were liable to be thrown out of service. When we were getting one thousand dollars a day, the owners held the crew responsible for getting there. The idea of boilers for a naval vessel or for a mercantile vessel is to have a boiler that is always ready.

MR. DU BOSQUE: This paper seems to decide in favor of a proper water-tube boiler and the inference is for the mercantile marine. It is surprising, therefore, that the author of the paper, who has spent a great amount of time on the paper apparently, has not studied the mercantile side of the water-tube boiler. There probably are more small-tube boilers in the mercantile marine than large type of boilers, and, I might say, running very successfully. The limitations that he gives here are probably the reasons why he has not described the small-tube type. He takes exception to screw joints in contact with heat, and he speaks of muddy drums and of large drums that should be used, etc. There is no doubt that the small-tube boiler in service, in the mercantile marine, is successful, which fact would seem to throw aside the conclusion drawn in this paper. A little further on in the paper it is stated that some of the small-tube boilers are expensive to operate and that all are more expensive to operate than a shell boiler. We have had some six years' experience with water-tube boilers, and about three months ago I was called upon to make a comparison of the actual cost of the different types. We have probably four of the different types in service. The up-keep, as I may call it, of the water tube was less than half of the up-keep of the shell boiler.

THE CHAIRMAN: Would the speaker give us some information upon the cost of operation? Does it take more firemen to maintain a plant of water-tube boilers?

MR. DU BOSQUE: I think it requires more skill to operate a water-tube boiler. I hesitate to give any points on the economic side, because the purpose for which we are using water-tube boilers shows that they are decidedly more economical than shell boilers; but I do not consider that the same comparison would bear in continuous service. In the six years that we have had water-tube boilers, some of them have operated twenty hours a day for ten months in a year.

MR. RAYNAL: In my desire not to keep you unduly, in the previous remarks that I made I forgot one thing. On page 26 of the paper the author states that the water-tube boiler requires great judgment and skill in its operation. Now, this statement is one of the many excellent ones made in the paper. I personally hold the belief that when water-tube boilers are better known by the firemen that have to handle them, or as well known by them as the Scotch boilers are to-day, then the so-called greater skill in operating will not be called for. It is a simple question of experience. Within the last fifty years we have not advanced in evaporation one-tenth. Our engine economy has been made better, but our evaporation capacity has not. If you want so many pounds of steam per hour you have to burn so many pounds of coal, which means so many square feet of grate, and that answers the Chairman's question. There are so many square feet of grate to be attended to. It depends a little bit upon the judgment of the designer. One will crowd his entire design in the grate, when he ought not to. Now, those are the conditions that so often confuse us. If I may be permitted another moment, I have with me some most important data on this very question. The economy of boilers, especially in re-

gard to navy purposes, has been lost sight of. When warships are designed they are designed for a maximum power, and the engineers are in the habit of saying, "We don't care anything about your economy." This question of economy is a most important one, because the rates of combustion vary so enormously. We read, for instance, the following data in the test of the *Cincinnati,* running all along from twenty pounds of coal burned per square foot of grate, up to sixty pounds. Then we read of one eleven pounds, etc., etc. What does it all mean? This question has disturbed me for a long time, and only a year or two ago when Professor Goss, of Purdue University, made some experiments with a locomotive boiler, using the rate of combustion from twenty to over one hundred, in a closed boiler, he produced a very uneven curve, and from that curve I dug out a formula.

MR. BABCOCK: In the tube boiler the economy depends entirely upon the amount of heating surface in the boiler, does it not?

MR. RAYNAL: To a certain extent. It should be stated as an effective heating surface. I found that every boiler has its own rate of evaporation.

MR. DU BOSQUE: Would a Babcock and Wilcox boiler, of the same amount of heating surface, burning twenty pounds of coal, show the same economy as a boiler burning forty pounds of coal?

MR. RAYNAL: Reduced to the same rate of evaporation, yes. I reduce it all to one rate of evaporation.

CHAIRMAN BOWLES: The point of economy and operation in the water-tube boiler has not yet been cleared up. In the navy they do not object to the introduction of greater skill in the fire room; the owner might. The naval architect, however, does object to the great increase in the number of the crew and in the amount of provisions and so on that they have to carry aboard ship. I invite Mr. Raynal to account for the large increase in the crews of naval vessels, which is laid at the door of the water-tube boiler.

MR. RAYNAL: Mr. Chairman, I am not sufficiently posted on the fact as to whether that is so or not.

MR. BABCOCK: On that point I think I can safely say that on the lakes the ships that have Babcock and Wilcox boilers have 50 per cent. more men than the other vessels.

CHAIRMAN BOWLES: That corresponds with the Chair's information.

MR. DU BOSQUE: I have experimented with 8,000 horse-power water-tube boilers, and I do not see how the fire-room force has been increased. We are operating on the ferryboats both with water-tube boilers and with cylindrical boilers, and exactly the same force is used on each of those boats. Therefore I cannot see any reason for the addition of 50 per cent. to the fire-room force by the use of the water-tube boiler, as has been suggested here. There is no more coal used for the water-tube boiler than for the cylindrical boiler. I think there are very few vessels of any size but what carry a water tender. A water tender can attend to a 2,000 water-tube boiler as easily as to a shell boiler.

MR. M. F. MOORE: The tendency of the times seems to be for everybody to do less work. I have fired a boiler, I know something about throwing coal, and I have seen the time when if a man couldn't handle seven tons of coal in a day he lost his job. But we cannot get a man to handle half that amount to-day, because the trade unions, and the other things that we are up against, won't allow it. If we had two furnaces to one boiler thirty years ago we were in luck; we often had only one furnace, and if you lost ten pounds of steam then you might as well get out on the deck when you came to one, because that was the end of you.

MR. RAYNAL: It occurs to me that on the question of economy I can cite a very good instance that has come to my notice recently. The cruiser *Cincinnati* had Scotch boilers. It was decided to change those to water-tube boilers, and they installed eight Babcock and Wilcox boilers. Immediately after the installation the ship was sent out. Since that time I have seen her log continuously, and I know it to be the fact that she makes 15.54 knots to-day on the same amount of coal burned where she formerly made only 10 knots. This is a ship that has the same propellers and the same low-pressure cylinder that she had before. The only change was that the size of the high-pressure cylinder was cut down considerably, and also that the intermediate was cut very little.

CHAIRMAN BOWLES: The Chairman's knowledge of this fact has been inferred from what the last speaker has said, and therefore the Chair feels obliged to state that the coal was not burned in the old boilers of the *Cincinnati,* but it was simply baked.

MR. NEWMAN: There is one point that Mr. Raynal has mentioned about the *Cincinnati* which I wish to refer to. In my opinion, the additional economy did not result directly from the type of boiler, except in so far as its ability to carry the high pressure of steam is concerned.

CHAIRMAN BOWLES: The Chair is perfectly aware that the comparison in regard to the *Cincinnati* has not the slightest bearing on the subject. The truth of the matter is that in the fire rooms of the *Cincinnati* it was utterly impossible to get enough fresh air to burn the coal, and it did not burn; it simply baked.

MR. BABCOCK: I do not rise to speak as an expert, but I want to say this, that whatever opinion any of us may have on the question of water-tube boilers or Scotch boilers, I think we must all recognize that Mr. Fairburn has collected a very large amount of data in his paper. I have taken some pains to get some additional memoranda in regard to the ships *Northwest* and *Northland,* to which he has referred in his paper. I am very glad to hear from Mr. Newman that there was one season at least when these steamers ran with some sort of satisfaction. The only way I can account for it is in the fact, as he says, that they imported Spanish firemen and a Scotch engineer, and I think they must have imported French water to put into the boilers. However, those boilers have been taken out and Scotch boilers have been put in. If you will refer to this paper you will see there is a table giving the particulars of the Scotch boilers originally proposed for those ships, and the Belleville boilers which were afterward put in. Now I have obtained from the manufacturers of the Scotch boilers these particulars: There were 10 Scotch boilers, 12½ feet in diameter, 11½ feet long, and three 38-inch furnaces in each, put into each ship. They carried 217 pounds steam pressure. The total grate

surface was 625 square feet; the total heating surface was 22,580 feet, making a ratio of 36.1. The weight, dry, including breechings and stacks, was 406 tons; wet, 513 tons. The indicated horse power was about the same, and it was stated to me that the ship used 1,150 tons of coal in making the trip from Buffalo to Chicago and return, with the old boilers, and with the new Scotch boilers, running on the same schedule time, used only 750 tons. One of the speakers has said that he did not see any reason why a greater force was needed in the fire room with the water-tube boilers. Well, perhaps they are not needed on the trip, but they certainly are needed in port to make joints.

MR. F. M. WHEELER: I quite agree with Mr. Babcock as to the time and pains that Mr. Fairburn has been at in writing this paper. There is really a very great deal in it for discussion. Personally I would like to speak about one or two points that are somewhat in my line. He speaks on page 5 of putting on to the pump so much labor as is provided under the Belleville system as being a great disadvantage. Now, in building feed pumps for these boilers we have to provide frequently for as high a pressure as 600 pounds. Of course, that means a test pressure of perhaps 700 or 900 pounds, according to the idea of the party who writes the specification. Therefore, doing away with regulating devices that were unreasonable, the pressure is very much to be desired, and I think it is very important, and I am very glad that the author of the paper has brought out that point so strongly. Then, again, he speaks of the oiling, etc. That is a good idea, and if it is possible to put such separators on the main exhaust pipe cylinders it would be a good thing, but of course that is almost prohibitory on account of the weight and the room. It is all very well to try and filter the grease out of the feed water, but I think we want to attack the other end of the problem first, and get it out of the steam.

MR. NEWMAN: Take the lubricators off.

MR. WHEELER: I am very glad you suggest that. We are trying to produce machinery to-day that will run without oil.

MR. BABCOCK: In speaking of the *Northwest* and the *Northland* I might have added that the boilers which they have put in now only take up about two-thirds of the space formerly occupied.

LONGITUDINAL BENDING STRESSES ON DAMAGED SHIPS.

BY GEORGE C. COOK, MEMBER.

Abstract.

This paper deals with the longitudinal stress developed in a ship when damaged so that loss of buoyancy is experienced due to the flooding of one or more compartments. Brief reference is first made to the conventional methods of computing such stress and of the scales which the author found convenient to use in the calculations for the illustration of the text. Five vessels are used as illustrations, ranging from the coal barge to the transatlantic cargo and passenger steamer, and these are assumed to have one or more compartments bilged, and the longitudinal bending moment developed is then investigated for various conditions—in smooth water, on the crest of a wave and in the hollow of a wave. For convenience the various results are arranged in tabular form and the author closes with some general conclusions based on the results thus developed. These are briefly that in vessels where the weight of the hull and machinery makes up the total displacement and the machinery weight is placed amidships, the result of a bilged amidship compartment is decidedly serious in both wave and still-water conditions. In the usual type of mercantile steamer there is more likely to be some reduction of stress when the vessel is bilged amidships in still water, and but slight increase when on the wave. The author believes that this question should receive consideration along with that of reserve buoyancy and stability in like conditions, and that such examination might lead to such changes in bulkhead spacing and compensating longitudinal girders as to promote the safety of vessels in such conditions.

DISCUSSION.

WILLIAM R. SATTLER: I would like to ask the author of the paper to add another column to that table showing the actual stress caused by these different bendings. In the last vessel that he cites there the stress of 123,000 feet a ton is nothing like the severest test. The maximum bending test is something over 300,000, if I remember rightly, when poised on the crest of a wave.

MR. COOK: I will say that I did not have the amidship sections there with these different vessels; but the statement is quite right that the maximum stress is below, even in the most severely damaged condition, the structural limit.

SURFACES OF BUOYANCY AND OF WATER LINES.

BY PROF. CECIL H. PEABODY, MEMBER OF COUNCIL.

Abstract.

The general problem of the floating body involves the discussion of the systems of forces which are developed by an inclination of the body about any conceivable axis. The usual elementary investigation relates to inclination about a longitudinal or transverse axis only. In such cases the path of the center of buoyancy for such inclination is a space curve which is usually projected on the plane of inclination. Similarly the continuous series of water lines cutting off a constant displacement will have an envelope known as the curve of flotation. In the more generalized problems these curves become surfaces and the problems relate to the space geometry of these surfaces and of their various sections. The special development of the geometry of these surfaces is due to French writers on naval architecture. The author's purpose in the present paper has been to present some of the more important problems relating to these surfaces, using methods which may be somewhat more familiar to those accustomed to English works on naval architecture.

As there was no discussion on this paper, the meeting was adjourned.

SECOND DAY'S PROCEEDINGS.

The fourth technical session was called to order at 10:30 A.M. with Col. Edwin A. Stevens in the chair. In the absence of the author of the first paper on the programme, the paper was read by Professor William F. Durand.

VIBRATIONS OF STEAMSHIPS, WITH SPECIAL REFERENCE TO THOSE OF THE SECOND AND HIGHER PERIODS.

BY REAR ADMIRAL GEORGE W. MELVILLE, U. S. N., VICE-PRESIDENT.

Abstract.

In this paper the purpose of the author is to discuss the importance of unbalanced inertia forces of the second and higher periods and of the vibrations which they may produce. The subject is dealt with under the following three heads: (1) Do important vibrations of second and higher periods occur? (2) Are the unbalanced forces of higher period in the four-crank engine important? (3) Are the forces of higher period sufficient to account for the vibrations of corresponding period? Regarding the first point the author refers to the recent investigations in the German navy, in connection with which a large number of diagrams, showing the vibrations existing at various parts of the ship, were obtained by special apparatus designed for the purpose. In order to intelligently interpret these diagrams the author first presents a series of diagrams resulting from various combinations of simple sinusoidal curves representing vibrations of varying amplitude and frequency. The comparison between the features of the resulting curves and their known constituents becomes thus an aid to the interpretation of the actual diagrams taken from the ship. These latter diagrams are then discussed and the conclusion reached that important vibrations of the second and higher orders are to be found in all cases furnished by the observations referred to above. The author then examines in detail the inertia forces developed by the engines of the *Deutschland* and shows that while they are balanced as perfectly as possible according to the Schlick system, nevertheless second- and fourth-period forces and moments of very considerable magnitude are developed. It is furthermore shown that with the ordinary spacing of cranks the fourth-order moments disappear, while the second-order moments and forces are substantially the same as for the Y.S.T. system. First-order forces and moments are, of course, not eliminated by this method, but the point of the comparison lies in the fact that the more complicated method of balancing is able to scarcely reduce the forces and moments of higher order, although it does eliminate those of the first order. Under the third heading the author discusses the relation between the disturbing force and the magnitude of the vibration which it may develop, and gives in tabular form the relative values of forces and moments which would serve to develop vibrations considered to be of "equal importance." The meaning of the term "equal importance" is defined as "vibrations for which the product of force by frequency is the same." The conclusion of this section of the paper is that forces of surprisingly small magnitude and of frequency higher than first order may be able to develop vibration of corresponding order, and of importance equal to those of the first order developed by much larger forces.

DISCUSSION.

A written discussion was presented by Naval Constructor D. W. Taylor.

Mr. W. L. Tobey: Mr. Chairman, I have understood that the vibration in vessels propelled by turbine wheels was very slight. If that is so, then that would support Admiral Melville's claim that the vibration due to the propeller would be disregarded.

Mr. R. L. Newman: I would suggest that if the propeller is made absolutely perfect, then there are no unbalanced forces.

Professor Durand: To anticipate any further reply I would say that on one occasion there were certain vibrations, more especially prominent at the stern, mostly of a transverse character. The statement was made in that connection that a careful measurement of the propellers had shown a certain definite and rather large lack of uniformity in the pitch, apparently quite sufficient to give some color to the assumption that such transverse vibration might have been due to the influence of the propeller. Even so, they were not serious; but such as they were it seemed more likely to relate them to a lack of uniformity of pitch rather than any other cause.

Mr. Tobey: The vibration might have been influenced by the rudder.

Professor Durand: The author of the paper quite agrees, I think, with Mr. Taylor, regarding the relative importance of balancing one set of forces and two sets of forces; that is to say, in regard to Table A, the author did not intend to imply that a lack of balancing on the part of the primary force was permissible, but to show that with the cranks arranged as in the usual way, while there would be introduced certain forces and moments of the first period, which were entirely absent under the Yarrow-Schlick-Tweedy system, those which were there by developing the second moment were sensibly no larger than those under the Y.S.T. system. In other words, that under either system of balancing, the secondary force and moments were very large and therefore presumably culpable for any of the vibrations of the second period which might be observed.

Admiral Bowles: I hope that it is not out of order to point out at this stage of the discussion that the intimation of the last speaker, that Naval Constructor Taylor and the author of this paper are in entire agreement on fundamentals, does not seem to me to be borne out by the remarks of Mr. Taylor at all. It looks as if the author of this paper would be required to write another paper to clear the matter up.

Mr. W. E. Kimball: I would like to state, speaking of propellers, that in the last trials of the *Lawrence*, the standardization trials of the *Lawrence*, they used a uniform pitched propeller, and on the standardization runs there were very perceptible vibrations which undoubtedly came from that propeller, even though they balanced it to their best ability and got the true pitch there. There is no way by which it does not have an effect on the vibration.

Chairman Stevens: Was the pitch actually measured in the propeller itself?

Mr. Kimball: Yes, sir. The propeller was cast, and then they used a spiral, and it was cut true to the spiral and very carefully balanced afterward. I think the propeller, from the measurements, showed that it was about as true to the true pitch as possible.

Admiral Bowles: I might add this. One speaker has alluded to the fact that if the propeller was made absolutely perfect the vibration which it gives to the

structure of the vessel might be eliminated. I will assume that if the propeller were made absolutely perfect and then run in water of infinite depth, and not in the vicinity of any structure like a vessel, it probably would not vibrate, nor would it cause vibration. But when it is run near the surface of the water, and in the stream line motions caused by the motion of the vessel, and also contiguous to stress supporting the rudder, shafting, and the hull, it will undoubtedly give rise to vibration no matter how perfect it may be.

MR. H. A. SWANTON: The engines of the torpedo-boat destroyers built and just completed at Sparrows Point are, as doubtless most of you know, of the four-cylinder type. The low-pressure cylinders are at the ends, with the high and intermediate placed between them. The two air pumps are worked from beams attached to the crossheads of the two middle or smallest cylinders. When balancing up these engines, Mr. John McAvoy, who made the calculations, claimed that, although when the engine is standing still the air pumps may partially balance the piston, piston rod, etc., nevertheless, when it is moving, the inertia of the air pump is added to, instead of subtracted from, that of the reciprocating parts to which it is attached. This is contrary to the general practice of working the air pump from the largest cylinder, and also contrary to the rules given by Naval Constructor Taylor in Appendix B of his paper of last year. These engines were balanced up according to this principle, and the reports I have heard of the behavior of these boats seem to prove this claim. I regret very much that I cannot speak from actual experience, but I have been told that there was very little vibration noticed, particularly at the highest speed, which was attained with about 330 revolutions or over 1,200 feet piston speed. If the engines were out of balance to the extent of twice the weight of the air pumps and gear, it would seem as if considerable vibration should have been noticed at this speed, although, of course, if the time of vibration of the hull was enough different from the time of the vibrations produced by the engines no bad effect might have been observed.

Judging from this, it would seem that the usual custom of working the air pump from the low-pressure crosshead was wrong and that a balance sufficient for all practical purposes of the ordinary triple engine might be attained by making the low-pressure piston as light as possible, with the intermediate of the same weight, and then working the air pump from the high-pressure crosshead, so proportioning the weights with the lengths of the beam that the resulting effect of the reciprocating parts would be equal to that of either of the other cylinders.

In the absence of the author the next paper was read by Mr. Forbes.

THE DEVELOPMENT OF MODERN ARMOR AND ORDNANCE IN THE UNITED STATES.

BY REAR ADMIRAL CHARLES O'NEIL, U. S. N.

Abstract.

This paper, from its title, is largely historical and presents a most interesting description of the development of ordnance and armor during the last forty years. Particular reference is made to the more recent developments beginning in 1883. Comparisons are made between successive types of guns of the same calibre, showing the advancement in the weight of powder charge and in initial velocity and energy of the shell. Reference is also made to the development of smokeless powder, special types of armor-piercing shells, and other items of naval armament. The second principal division of the paper relates to the history of the development of armor, in particular from 1888 to the present time. The paper closes with a list of vessels of the navy carrying armor, and showing the character of armor fitted.

DISCUSSION.

MR. HOVGAARD: I think it might be added to what the author has stated in the paper, that it was really the introduction of the explosive shell more than anything else, perhaps, that forced the adoption of armor.

MR. FORBES: This paper is most interesting, and I want to add some little matters of history. I find that the first cannon in the United States was cast in 1647, in Lynn, Mass., by Henry Leonard. In 1648 brass cannon were cast in Bridgewater, by the Orr foundry. In 1775 18-pounders seemed to be about the largest guns cast on American soil. They got so proficient in them that in 1776 they cast one a day at the Joy Foundry in Reading, Pa. At this time a man by the name of Clapp got up a machine for boring cannon, and a committee of safety, of the State of Massachusetts, agreed to buy it if the Mr. Orr, before referred to, considered it good. I should, therefore, judge that before that date no bored cannon were used. In 1794 General Knox, Secretary of War, contracted with the Hope Furnace for 22-pounders at $106.66 per ton. In 1795 Secretary of War Fickens contracted for cannon at the following prices, which may prove interesting here: 22-pounders, $420; 24-pounders, $350; 18-pounders, $318; 12-pounders, $211; 9-pounders, $140; 6-pounders, $130. In 1790 William Denning made a cannon of wrought-iron staves, hooped around with iron—and this I find is about the first record of any built-up cannon—and the material was staves brought from the Tower of London. In 1815 Col. Bomford, of the Ordnance Corps, contracted with R. L. Stevens for elongated shells made by a secret process. I understand that although the name of Robert L. Stevens is connected with these shells, it was not he who was the inventor, but Mr. E. A. Stevens, the father of our chairman this morning, who was the original inventor, and the shop where I now do business was the point of ground from which the first one of these shells was fired. In 1812 the Bureau of Ordnance was established. Now, this is something which I wish to close my remarks with, and I think it is very interesting. In 1811 a committee of Congress reported that the founders in the various States had arrived at a perfection in the art of boring cannon, it being so well understood that our inspector of artillery has declared to the board that he never was compelled to reject a single gun on account of a defect in the bore, although he has examined over 2,000. This goes to show that there has not only been a great change in the artillery, but in the inspectors too.

CHAIRMAN STEVENS: The Chair would call attention to the great value to the Society of recording historical data of this nature. Many of these facts would have been very difficult to get at by the ordinary member,

and such a paper forms a very valuable addition to the records of the Society. The Chair would, therefore, feel that the usual vote of thanks to Admiral O'Neil be given with very marked emphasis.

REMARKS ON THE NEW DESIGNS FOR NAVAL VESSELS.

BY REAR ADMIRAL FRANCIS T. BOWLES, U. S. N., VICE-PRESIDENT.

Abstract.

In the preparation of the recent designs for the battleships of the *Connecticut* class and the armored cruisers of the *Tennessee* class, consideration has been given to the matters affecting the time required for completion. Of the ten completed battleships of our navy the average time required from the date of contract until the date of first commission has been four years eight months. One of the causes of delay, which it is possible for the navy to remedy, is the insufficient number of plans issued to the contractor by the Government. In these new ships there are no less than twenty-one contract plans given out by the department, and the specifications have been arranged in a logical order and made in all particulars definite and conclusive. Another feature which it is expected will reduce the time of construction is that all the plates and shapes entering in the steel structure are of commercial sizes. Many special features are found in the design of the new battleships and cruisers, chief of which is the increased displacement. In comparison with the *Maine* class, in the new *Connecticut* class the displacement is increased 33 per cent., resulting in an increased weight of discharge in all guns above six-pounders of 47.9 per cent., and the weight devoted to protection is increased 44 per cent. Other very interesting comparisons are made with the *Oregon* and *Kearsarge* classes, and discussing the *Tennessee* class of cruisers. Comparison is made with the *Pennsylvania* class, where an additional weight of 29.7 per cent. of guns and ammunition is given, producing an increase in the weight of one discharge of battery of 47.7 per cent. The speed of the two types will be the same, namely, 22 knots. A few of the principal dimensions of the battleships 18 and 19, namely, the *Connecticut* and *Louisiana,* are as follows:

Length over all	456 ft. 4 ins.
Length on L. W. L.	450 "
Breadth, extreme	76 " 10 "
Mean draft to L. W. L.	24 " 6 "
Displacement to L. W. L.	16,000 tons.
Freeboard, minimum, at full load forward	18 ft. 2 ins.
Freeboard, minimum, at full load aft	17 " 9 "
Normal coal	900 tons.

Engines, No. 2; type, vertical triple expansion.
Diameter cylinders: H.P., 32 1-2 ins.; I.P., 53 ins.; L.P., two of 61 ins.
Stroke, 48 ins.

Boilers, No. 12; type, Babcock and Wilcox.

G. S. total	1,100 sq. ft.
H. S. "	46,750 " "

Steam pressure, designed, 250 lbs. at engines, 265 lbs. at boilers.

Designed speed	18 knots.
I. H. P.	16,500

ORDNANCE.

Main Battery	Four	12-inch B.L.R.	40 cal.
	Eight	8-inch " "	"
	Twelve	7-inch R.F.	45 "

PROTECTION.

Armor:
Water-line belt, top, 11 ins.; bottom, 9 ins.;; decreasing to 9, 7, 5, 4 ins.
Upper casemate, 7 ins.; lower casemate, 6 ins.
Upper athwartship, 7 ins.; lower athwartship, 6 ins.
Barbettes..... { 12, 10 and 7 1-2 ins.
{ 8, 6 and 4 ins.; sponson, 2 ins.
Turrets..... { 12—12 ins. and 8 ins.
{ 8— 6 1-2 ins. and 6 ins.; diagonal, none.

Particulars are also given of the new armored cruisers No. 10 and 11, namely, the *Tennessee* and *Washington,* and plates of the general arrangements of both ships are included.

DISCUSSION.

MR. HOVGAARD: I think the Navy Department is to be congratulated on the design of the new type of large cruisers. There are two principles regarding the mounting of guns which I think are generally accepted by naval officers and others. One is that the best gun position should be utilized by placing the heaviest guns in those positions, or else placing twin mountings of the same guns on either side of the vessel. The second principle is that the gun ought to be given a protection which bears a certain proportion to the importance of the gun. The gun placed in the most important position should be most carefully protected for that reason. I think it is interesting to see how these principles are followed out in the vessels. I refer more particularly to the *St. Louis* and *Pennsylvania* class. In the *St. Louis* class we have a ship of 9,800 tons, carrying fourteen six-inch guns. Of these, two guns are placed in the end position, and these guns are protected only by the sheath. The other six-inch guns, facing the broadside, are given four-inch armor. If we compare these with the same class of guns in the English navy we find that these ships carry in each end position twin turrets mounting six-inch guns. These twin turrets are protected by five-inch armor, and all the other guns are protected by four-inch armor. Their ships have the same displacement as the *St. Louis,* fourteen-inch guns, and 22,000 horse power as against the *St. Louis'* 21,000. In the *Pennsylvania* designs we find the two ten-inch guns at each end protected by the turret hoods, and by barbettes carried right down to the protected deck and enclosing the whole substructure and mechanism of the gun. If we compare these with the same class in the British navy, which is a very good comparison, because that is 14,100 tons as against the new design 14,500 tons, they carry sixteen six-inch guns, the same as the new design of ours, and they carry at the end two ten-inch guns. So the difference is in the principles which have been utilized in our two ships. The length of these vessels is practically the same, 500 feet. The speed only differs by one knot. I think these new armored cruisers may probably be called cruiser destroyers. The great swarms of protected cruisers which exist at the present time, in all navies, will find their most dangerous enemy in these new vessels of ours.

MR. W. C. DOBSON: There is one point, perhaps, where it seems to me that the admiral has been at fault to support his gun turrets rather more than of the necessity caused by the use of the Babcock and Wilcox boiler. However, there is only one point where I can see where any saving could be made in the disposition of the weight.

Mr. Henning: Admiral Bowles in the reading of his paper inserted a little remark which does not appear in the print, which might be of interest to the members. He made the statement that it was not easily possible to compare the relative cost of ships of the same size of those built abroad and those built here. He recurred to the cost of armament and said that that was an unknown quantity. Now, I recently had a little experience in trying to get some material that was ready in the gunshops of two of the largest works of this country and which was exactly in line with gun work. I wanted to purchase steel of the same kind used in the guns, and the quality I wanted was of the highest order. When I got my estimate from two of the largest shops in this country the cost was $23,600 per ton. That, of course, made the work I wanted done prohibitive. So I went to Crookes and I got exactly the same work, delivered in two-thirds of the time, for $6,680 per ton. There was not a ton of material in what I wanted, but I had to pay that rate for it. I think that explains why we cannot make any comparison in the cost of armament between foreign ships and ships built here.

Chairman Durand: I think the Society is to be congratulated on the fact that Admiral Bowles has not lost interest in the Society, and that he has been able to turn aside from his duties in Washington and present this paper before us.

WHY IT TAKES SO LONG A TIME TO BUILD AND EQUIP A NAVAL VESSEL FOR THE UNITED STATES.

by George W. Dickie, Member of Council.

Abstract.

In this paper the author, while not desiring to find fault with the present system of producing naval vessels by contract, points out the chief causes of delay in building these vessels, the most important of which is the habit which has hitherto prevailed of designing the vessels while they are under construction. The plans, which are made by the contractor, are first criticised by the superintending constructor, and possibly returned several times for changes before the latter submits them to the bureau at Washington. There they may be entirely rejected, in which case the contractor must draw them over again. To expedite matters the design should be completed before the contract is signed, giving location and dimensions of every compartment, dimensions of armor plate, the question of armor and armament should be definitely decided upon, and the magazines should be worked out in considerable detail. All arrangements of machinery should be shown, and allowances made for the space taken up by bulkhead stiffeners in laying out the plans. The drainage and ventilation system should also be part of the original design. Many of these points the author understands will be embodied in the new contracts. The comparison is made between the Bureaus of Construction and Repair and Steam Engineering in favor of the latter. It is recommended that the builder should prepare his plans as he thinks would best carry out the requirements of the specifications, and submit these to the bureau through the superintending constructor, who would give the bureau his opinion and recommendations in regard to them. Thus the drafting and designing work of the latter would be abandoned. In the opinion of the writer the naval constructor should not be the naval architect; neither should he be the shipbuilder, unless in the first case he is responsible for the design, and in the other he is to find out the wherewithal to meet the obligations of the payroll. The author closes with the statement that his criticisms are in reference to the system and not against the naval constructor.

DISCUSSION.

Mr. R. C. Monteagle: Mr. Chairman and gentlemen, it seems a matter of regret that a member of this Society should have made such invidious comparisons between the methods and men of the two great naval departments of the country. These comparisons are none the less invidious that they are coated with sugar. Stripped of all verbiage, Mr. Dickie's paper is an attack, and to make his object entirely beyond doubt he compares the methods of the two bureaus. The old proverb that "comparisons are odious" never was more fitly illustrated. My quota of experience with naval constructors is that they simply require "the result to be attained" and do not attempt to force their methods on the contractor, supposing their methods to be at variance. Any contractor who yields to an inspector of machinery or construction, in the matter of methods of doing work, does so by his own choice. He is not obliged to do so by any law nor custom. In regard to the use of material which has not been tested, in places where there is no severe strain, all that is necessary in such a case is to get permission from the inspector to use such material, and I have never known an inspector who would refuse to do so in a reasonable case.

Admiral Bowles: I presume I am expected to say something on this paper. First, I want to acquit Mr. Dickie, the author of the paper, of any collusion with me in the preparation of this paper. Just imagine the dismay of the author of the paper and of some others if I were to reveal the secrets of my position to members and tell what I know about contractors. Now, it might be well to examine for a moment how people inspect their vessels who pay for them out of their own pocket. Do they rest with the inspection of their most distinguished captains, commodores, or whatever they may be? As a matter of fact, the inspection of the hull is conducted by the registration societies, men who have spent their lives in technical study of their profession practically and theoretically. Not only that, but the great steamship lines maintain a technical staff of their own, principally devoted, however, to the inspection of machinery. We have been building battleships only for a period of about ten years, and it was not wise in the preparation of the original designs to go into them in detail, when the problems to be worked out were to be guided by conditions which had not been developed. That, however, now is practicable and has been followed out in the most recent designs. The variable conditions have been eliminated as far as practicable, and will continue to be, more and more definitely. The Navy Department, however, pursues practically the same course with regard to the carrying out of its contracts that other people do, and nothing

more. It is not necessary to tell you that contractors as well as constructors in the navy are human. In regard to the author's complaint, I think that a sufficient reply to him is simply to say that it is well known that the firm with which he is connected has built some very successful ships. One of them steamed around the Horn. Now, if the author is willing to share with the navy constructors a proportion of the credit which he assigns to them in his paper, I am quite satisfied.

A somewhat animated personal discussion between two of the members here took place, owing to an attack of the first speaker on our navy's methods of drawing specifications and superintending work, in comparison to Lloyds' and the British Admiralty's systems of conducting this work. In the rejoinder the second speaker authoritatively stated that the specifications of the British Admiralty are far more vague to-day than ours ever have been; they leave everything practically to be settled at some future time, and their inspection is by no means equal to ours in any respect whatever. There is no comparison between the perfection of detail upon our vessels, with regard to military power and adaptability, and those of the English navy; and controversies can be pointed to which have existed between shipbuilders and the Lloyds' Registry over a series of twenty years, of violent discussions as to who shall control the design of vessels.

A written discussion prepared by Naval Constructor Cawresey, stationed at the Union Iron Works, was here read and the meeting afterward adjourned until 2 P.M.

FOURTH SESSION.

Upon the meeting being called to order by the Chair the adjourned discussion on Mr. Dickie's paper was taken up.

MR. W. C. DOBSON: I refrained this morning from taking any part in the discussion, thinking that my honored chief, Mr. Charles H. Cramp, would be here and present his views in his own manner. I regret, however, that I am in receipt of a telegram from him stating that he is too ill to be present at the meeting, and wishing me to apologize to the members for his absence. I regret that Mr. Dickie has seen fit to take a view of the relation existing between the superintending constructors and the contractors in matters of opinion which arise between them, for it gives me particular pleasure to bear testimony to the very amicable relations existing between the superintending constructor and his assistants and our own people. It is only by the hearty co-operation of the superintending constructors that we have been enabled to turn out such products of excellent merit as the report in the morning newspapers of to-day seems to indicate in the case of the *Alabama* and the *Massachusetts*. I have always found, in my experience with the superintending constructor and assistants in our yard, that whenever we have a plain, straightforward, and square proposition to submit to them we are always met more than half way, and that we have nothing whatever to complain of in respect to treatment at their hands.

CAPTAIN LAWRENCE Y. SPEAR: I would like to speak regarding the number of times that the working plans passed between the contractor and the superintending constructor before the latter was ready to sign them. Now, I have found that the contractor, being busy, oftentimes depended upon the superintending constructor to keep many of his plans straight for him. The plans were sent in such a condition that they required an immense amount of checking up, and the time so spent was ultimately saved in the building of the ship. A number of times I have had the contractor, when I was on the other side of the fence, admit that fact. But I think that in a number of cases there is a little injustice on both sides. I think a number of times there have been delays on the part of the naval constructors. One of these is because it has been the case for five or six years that most of the constructors are supposed to be in four or five different places at one and the same time. Again, we all know that there has been an enormous demand for competent draftsmen, and we have all had to put up, on both sides of the fence, with somewhat inadequate help. The result has been that the contractor has sent out improper plans. The result, on the other side, has been that an undue amount of time has been devoted to correcting those plans. So that, all things considered, I think that the delay on both sides about evens up. The personal equation of both the superintending constructor and the representative of the contractor is a most important element in the whole thing. If a contractor when he begins work consults the superintending constructor, and if the latter will consult with the contractor, get in the drawing room together, why, a great deal of the trouble will disappear. But the trouble has been that by the time the plan reaches the superintending constructor it is generally in such a shape that he cannot approve it without trouble. One of the reasons why that cannot always be done is because the superintending constructor has had, as I have said before, so many things to attend to.

LIEUTENANT COMMANDER H. C. WHITE: There was some reflection in the past about an old sea dog inspecting a ship. Now, I don't know but there may be an old sea dog inspecting ships to-day, but I have not seen many of them. Certainly, the officers who are the inspectors of equipment and ordnance are very far from being as old as they might be. The work of installing electrical equipment on board ships of war has been worked out by officers of the navy. It is the experience of those officers in the use of electricity on shipboard, and the repairs of the electrical plant after the ships have returned from voyages, that have brought about the changes in the specifications which are noted by Mr. Dickie. If we did not change our specifications from time to time as the requirements dictated, we should be very slow in our progress. Now, the one point in regard to the inspection of ships is the line officers who are detailed in the yard; they have no part in the construction work at all, and there never has been any attempt or any desire on their part to interfere or to criticise the technical part of the work. There are details which come under the officer's experience on board ship, the arrangement of the compartments and the arrangement of the ship, which might very well be referred to the officers who serve on the ships. The demand on an officer's time for the inspection of the

crew and for the necessary work that he has to do, gives him very little opportunity—unless he takes it at odd hours, the hours when other people are enjoying themselves—to learn about the ship. The condition of the ship after they have been on cruises from three to six years depends entirely on the care with which the officers of the ship make their inspection and the knowledge that they have of the structural make-up of the ship. There are very few line officers who are available for duty of that kind on shore, and it is in my opinion a very important point in an officer's education.

MR. DU BOSQUE: The writer speaks of the interference of naval constructors in the methods of construction, and in the matter of design, and of adherence to standards. Of the first cause I think that the constructors to-day are perfectly excusable, because if there is any interference it has come to them as a sort of an inheritance. We can probably all remember that when the upbuilding of the navy was commenced, in 1882, the initiative was taken by the constructive corps. I might say that some of the shipbuilders looked upon the designs submitted to them by the constructive corps with exceeding doubt, thinking that they would not be strong enough to do the work intended. After the contracts were placed the shipyards were very glad, however, to avail themselves of the knowledge that the constructive corps had gained by its representatives abroad. They were also very glad to adopt these recommendations from the constructors as to the kind of tools that should be used in the manufacture of this new style of ship, and I am sure that some of the most important yards in the country to-day can trace their early progress to the advantage that they have obtained from the young constructors in this country. As to the matter of standards, it is quite surprising that the navy has not progressed faster than it has in regard to the adoption of standards. The navy has a great number of units afloat on vessels that contain a great number of working parts which are very apt to break down. It seems very essential, especially to the navy, that standards for these fittings should be adopted, and I can only point to the different transportation companies that find to-day that it would be almost impossible to conduct their business successfully if the numerous parts that go to make up the machinery that they use in operation were not made standard.

MR. A. G. RUTHERFORD: Although I sympathize in some particulars with Mr. Dickie in his troubles, yet I hardly think that he has made out a clear case as to why it takes so long to build a war vessel. I think there are two important points which contribute to the loss of time, which he has not mentioned in the paper, and I believe they are points which are not in the minds of the gentlemen here present. One is the poor delivery of material. I refer now particularly to structural steel. There are few manufacturers of material who are so ignorant of the material that they have to furnish as those who are engaged in steel production. Why, we often get bulkhead stiffeners supplied to us before we get parts of the framework, and not infrequently I have known owners to send a practical man to remain at the steel plant to see that they got reasonably fair play and that the proper materials were sent them in the proper order. Another important thing is the getting of suitable workmen when a job is sufficiently far advanced to enable you to proceed with the work. Men who are accustomed to light inside structural work cannot be entrusted with shell plating, for example.

SECRETARY CAPPS: I am going to speak a word for Mr. Dickie now. I am one of the unfortunates who was a superintending constructor at the Union Iron Works, but never heard of any troubles that took place in the years of my administration there. Mr. Dickie, as you may not all know, is one of the most charming personalities that I have ever met, and a very profound humorist. But leaving the humorous side of the question, there should be no real difference between the constructor and the manager or president of any establishment. Their interests are absolutely the same, for they are trying to accomplish good results, each in his own proper way. I think the experience of most people is that their relations are harmonious. As far as the firm represented by the author of the paper is concerned, I think they have a great deal of glory in the vessels that they have turned out, and if their trouble has been quite as serious as might appear from a cursory reading of the paper, the magnificent record made by the *Oregon* and the *Alabama* would not be known.

President Griscom here assumed the chair and in the absence of the author the following paper was read by Lieutenant Commander White:

THE TACTICS OF THE GUN.

BY LIEUT.-COMMANDER ALBERT P. NIBLACK, U. S. N., ASSOCIATE.

Abstract.

The author's argument is that the battleship is the epitome of sea power and all calculations for defence must be based on the battleship as a unit. While protection from other classes of vessels, such as torpedo boats, should be considered, the battleship is primarily meant to fight battleships on the high seas, and it is this view of gun against gun that is dealt with in the paper. The author believes that it is only by luck or by indirection that a model battleship can sink another by gunfire alone, and in the future ships will probably not be set on fire as at Santiago and Manila.

The object of tactical manœuvers of a fleet previous to or in a fleet engagement should be: First, to get the enemy within a close effective range; second, to get a superior position in order to mask some of his fire or increase the effect of your own; third, to hold an advantage gained, or, losing it, to manœuver for a fresh one; fourth, to avoid waste of ammunition; fifth, to get out of a position of disadvantage or one in which a move of the enemy may threaten to place you; sixth, to concentrate gunfire on certain ships of the enemy, in order to reduce the tactical efficiency of all his ships by crippling one or more; seventh, but of all things to deliver a rapid, crushing fire at the earliest possible moment, thereby injuring at once his initiative and increasing your own offensive power in a geometrical ratio as you destroy his.

A comparison is made between the tactics of the sailing ship period and that of the modern steam fleet. In the days of the former, as all guns were necessarily mounted on broadside, the bow and stern fire was in-

considerable, the only formation was in column, and the preliminary manœuvering was generally to secure the windward position. In an army on shore, on the other hand, the line must necessarily be the offensive formation, but with modern battleships the installation of pairs of heavy guns in the ends of the ship and the introduction of the ram and torpedo have changed naval tactics to a sort of compromise of sailing ships and military tactics. The function of the gun is to destroy the battery and *personnel,* as armor and the water-tight subdivisions make it well-nigh impossible to reach the vitals of the ship with gunfire alone, except with plunging fire at long distances, and destruction is the function of the ram and torpedo. The author makes a strong plea for retaining the submerged torpedo, which has been omitted in the most recent design for battleships. In a very interesting series of diagrams, he illustrates the area of maximum concentrated gunfire of a fleet in different formations. Since the Santiago battle the navies of the world have been paying close attention to gun practice, and the rapidity of discharge and number of hits of the guns of the English fleet show a wonderful marksmanship, and it is these two points which will tell in engagements. Efficiency in gun practice in our navy is lowered because of the continual change in the *personnel* of our ships and the small appropriation for gunnery exercises, which amounted to but $12,000 for the current year. In closing an appeal is made for the navy's consideration by Congress, and especially for an increase in the appropriation for target practice.

DISCUSSION.

Admiral Bowles: I think the Society is much indebted to Lieutenant Niblack for bringing to our attention the essential purposes for which these great ships are built. The only criticism that he makes upon what is being done is that of the omission of the submerged torpedo boat, and he is at a loss to understand why the Board of Construction came to that conclusion. I really do not feel called upon to defend the Board of Construction, and I will simply state my position in the matter. When the members of the board conclude that a submerged torpedo tube is not a desirable thing, you may readily imagine that I, as a constructor, am very pleased to leave it off.

Lieutenant White: I will say that the paper will perhaps explain in a way the reason for our desiring ships of such great size. If you could take a whole fleet and compress it into one vessel—that is, the aggressive power of a whole fleet and compress it into one single vessel—you would realize what I mean. The leading ship of the line in an attack will bear the brunt of the attack. The defensive properties of that ship must be great enough to meet that attack, and her offensive properties must be as great as possible in order to defeat it. The concentration of fire, to which the author of the paper calls attention, will be directed always upon the nearest vessel, of course. The leading ship of the line, which will be the admiral's ship, will be subject to the greatest attack necessarily, because our modern battles will be more or less a battle of follow your leader. The idea of being able to signal during battle is, I think, an exploded one—at least from our experience in the matter. I would like to call attention to the matter of our ordnance expenditures. It will be necessary, in order to bring the offensive powers of our vessels up to the very highest point, to armor them completely with the latest modern guns and modern gun mounts. To that end almost all the broadside guns now on our ships will have to be remodeled. I think the author places entirely too much reliance upon the use of the ram. I do not believe the ram will ever be used, as it is entirely too dangerous for the vessel that has the ram. In fact, probably both vessels will go down. Then, in regard to the defeat of a ship, he seems to think that if the personnel on deck is commanding the batteries the ship would still be a dangerous weapon. Now, it is the experience in the past of the naval battles, that, after a certain percentage of the personnel has been put out of action, that practically destroys the unit in which it is contained.

SUBMARINE TORPEDO BOATS—PAST, PRESENT, AND FUTURE.

BY LAWRENCE SPEAR, MEMBER.

Abstract.

This paper presents first a brief and well-condensed abstract of the history of the submarine boat from the first of the last century to the present time. The three leading nations in the construction of the modern submarine are stated to be France with a total of 44 built, building, and provided for; Great Britain with 10, and the United States with 7. The vessels composing these various fleets are taken up in further detail and discussed with reference to their historical development and their technical features. Reference is made in particular to the type accepted for the United States naval service, the Holland, and the leading features and possibilities of the system are presented in detail. Regarding the future the author gives his reasons for believing in the further development of submarine boats under four types and two main groups, to conform to the different conditions in the different maritime countries. These are as follows: Group 1 would be suitable for many of the European countries, and would include the large *offensive submersible,* self-supporting, with auxiliary bottom working features, and the small *defensive submarine* for torpedo work only. Group 2, suitable for the United States and similarly-situated countries, would include the small *offensive* ground working *submarine* or *submersible* (with auxiliary armament) and the medium-sized *defensive submersible* for torpedo work only.

The paper is illustrated with a number of plates relating to the historical development, and to the modern boats of the Holland type.

DISCUSSION.

Mr. Lewis Nixon: One great drawback to submarine navigation in a practical way was the fact that we could not depend upon a hydrocarbon engine until a few years ago. When the department outlined most of the qualities which fixed the design of the *Plongeur,* Mr. Holland, with whom I used to discuss the subject a great deal, was very anxious to have some submarine boat built, but I pointed out to him at the time that it would only result in disaster, as it was impossible to put three engines and a boiler in a place where men would want to live, and I refused to be connected with

the building of such a boat. He came to me, however, when the boat was well along, and we found we could get a hydrocarbon engine which was satisfactory, and in that we started the original Holland boat which has been the forerunner of the present boat. So far as speed is concerned, I am not one of those who believe that excessive speed is necessary in these boats. I think the submarine boat is made for defence, and that it must necessarily move slowly. Eight knots, however, on top of the water, and seven knots under the water is a very fast speed, as fast probably as some of our ships of twenty years ago, and it is all that seems to be necessary in the present condition of submarine warfare. Of course, if we could better the engine we could put more power in the boat, but whether in doing that we would not sacrifice some of the manœuvering qualities of the submarine boat is a question that leads to doubt in my mind. I think the submarine boat as built originally by Nordenfeld was, as Mr. Spear points out, a very mistaken conception. The submarine boat, to be used for defensive purposes, must be used after sounding and must be short enough to get at the bottom of a ship in comparatively shallow water; in other words, to be in a position to nibble at the boat and fire a torpedo at her. This would be impossible in a very long boat. I think the French have sacrificed a great deal of the manœuvering power in order to obtain the other qualities of the boats of this class. I do not believe in what Mr. Spear calls the submersive boat. A Jack-of-all-trades, even in ships, is a poor article. In other words, to be a perfect submarine boat, I think we would have to sacrifice too much if we wanted to make that boat capable of fighting on the surface. When Mr. Whitney was Secretary of the Navy we had a board which proposed a heavy armored submarine boat, a submerged boat, laying itself a little deeper in the water when in action, but which was supposed to be able to get up to a great battleship and stand the attack of her guns, if necessary. That may possibly be a development of the future. We have in the hydrocarbon engine possibly a great surface speed, and I think probably it will be necessary to keep some form of motor of this kind on a boat, as the boat would then be self-contained.

MR. MONTEAGLE: I think the gasoline engine is in many respects the best, but it also suffers from drawbacks, such as danger of explosion and the fact that it cannot be reversed, started, and adjusted without the use of external means. This means complication, of course, and these drawbacks are likely to be aggravated when you come to the higher power. I think it is very likely that we shall want greater power, because when all other resources are exhausted for the improvement of a type of boat there is always one resource left to the naval architect, and that is an increase in displacement. The steam engine has not in this country been given a fair trial in these boats, because the case of the *Plongeur* I do not consider a good example. There 1,500 horse power was cramped in a very small boat, and the result could hardly have been different than it was. The steam power is used in France in conjunction with electricity in these boats, and with a fair measure of success. These boats are not greater than 200 tons, and there are examples of these boats having made voyages from Cherbourg to Havre and back again within 21 hours—a distance of 142 miles. It is said that the crew suffered exceedingly from the excessive heat, but they managed to stand it, and the boat did the work, and they were under water for two hours continuously when they discharged torpedoes. This shows that the steam engines can be used in a similar boat. The French are not quite satisfied with this type, and they are now trying an additional motor. They do not seem to have entire faith in the installation, for they have provided that in case they do not work satisfactorily they are to be exchanged. The construction of all these boats has been suspended by the French Minister of Marine because he wants to see tests of the different types before he settles on what he thinks will be the best type. For purely submarine work we have at present probably nothing better than electric power. In France the Minister of Marine has invited a famous chemist to design the machinery for the new boat where liquid air is to be used.

ADMIRAL BOWLES: I want to make a few slight criticisms on this paper. I am in the dark as to what is meant by submersive and what is meant by submarine, and what is an offensive submersive and a defensive submarine boat. I am appalled at the fact that there are two groups now of submarine boats, with four sub-divisions. I do not think it is fair to spring so many things upon us all at once. There is no doubt that the submarine boat as it exists to-day is in a measure a success, particularly in those built for the United States Government. There is no doubt also that the boat has some value as it is now. It has an undoubted moral value. The offensive military value of a submarine boat with a speed of eight knots on the surface, and making as much fuss as a battleship, however, I should think, is seriously open to question.

A MEMBER: There is one use of submarine boat that I think ought to be mentioned, and that is a battleship carrying a submarine boat as part of her equipment. A submarine boat can be built perfectly workable, having a displacement of 15 or 20 tons, and 30 to 40 feet long, which could be carried on board a battleship, like the other boats. When that vessel is in a foreign port, she could use that submarine boat for reconnoitering in and out of the harbor. I might at the same time say that I do not think it is at all necessary to have high-speed submarine boats. I had the misfortune to construct one in England in 1886. As soon as I went below the surface I could not see at all. Another trouble was the compasses; as soon as I was submerged my compass was not reliable within two or three points. Of course that could be got over by artificial means, and not using a compass at all.

MR. F. G. HALL: I want to say in reference to the gasoline engine that it seems rather odd that they should have stuck entirely to the gasoline engine when, in the last four or five years, there have been engines used for commercial purposes, and on launches and on various surface boats, up to 30 horse power, and they could be used just as well on submarine boats. No large engines have ever been built to burn kerosene oil for submarine boats, but I am familiar with the workings of some of these engines, and it has been stated by one manufacturer that I know of that such an engine could be built, of 160 horse power, which

could be used on a submarine boat. It would seem that that class of engines should have a hearing before the gasoline engine, owing to its great safety.

Mr. Spear: I will be very brief in answering the remarks that have been made. In regard to compasses getting out of order when the boat was submerged, I will say that the fact that his compasses did not work proves nothing. We have had compasses that do work. It depends upon the compass, and upon knowing your compass. Passing now to what Mr. Nixon said, I want to accord my hearty agreement with him in the folly of attempting to force the man that is building submarine boats to build one to run as fast as a battleship. I gave my opinion as to what I thought the future might develop. I agree with Mr. Nixon about the necessity of going slow and not sacrificing manœuvering qualities. Mr. Monteagle has pointed out one of the difficulties in connection with the explosive engines. Considering the fact that one of our boats ran 12 hours at full power, which no surface torpedo boat can do, and which no naval vessel can do without difficulty, I think that is a good example. So far as the ability to work those engines at the speed which they have to work is concerned, that is now a matter of record.

Owing to the lateness of the hour the President stated that the two remaining papers would be read by title only.

MEASUREMENT RULES FOR YACHTS, WITH SPECIAL REFERENCE TO RACING CONDITIONS.

by F. W. Belknap, Naval Architect.

Abstract.

This paper gives an historical sketch of the rules for measuring yachts extant in England and this country, and shows how the change in the rules brought out different types of vessels. In each type one or more features, such as load-water-line length, length over all, depth, beam, etc., have been accentuated at the sacrifice of others, so that the resulting types have been more or less of freak design. In recent letters sent out by the New York Yacht Club to many yacht designers on this side and abroad, it was the opinion that displacement should be the ruling element in determining the rating. Most of our designers believe that the present rules should not be continued and that a craft capable of going to sea should be the adopted type. The English designers believe that their present rule is satisfactory. It is as follows: Length + beam + .75 girth + 4 times the difference between chain and skin girth + .5$\sqrt{}$ sail, the whole divided by 2.1. An American rating, while taxing the dimensions, should leave the design of the model entirely to the naval architect and should in no way handicap the model.

PRIZE COMPETITION PAPER.

Balancing of Valve Gears.

by L. D. Lovekin.

Abstract.

This paper is divided into two main parts, the first dealing with the theory of the inertia forces developed by the moving parts of the valve gear, and the second with the description of a form of balance cylinder intended to carry as perfectly as possible the combination of weight and inertia forces which are due to the combined action of gravity and the inertia of the moving masses. The author shows that by a suitable arrangement of ports in the balance cylinder a steam diagram may be obtained which, representing the history of the action of the steam on suitably proportioned pistons, will result in very closely balancing off the gravity and inertia forces above referred to, and will thus leave little beyond the resistance due to friction to be overcome by the valve rod and eccentric gear itself.

Votes of thanks to the American Society of Mechanical Engineers for the use of its assembly room during the convention, and to President Griscom, were then proposed and passed and the meeting was adjourned.

Saturday was devoted to inspecting the plant of the New York Shipbuilding Company, Camden, N. J., at the invitation of Mr. Henry G. Morse, president of the company. A special train took about two hundred and fifty of the members of the Society to Camden, arriving at about half past 11. As the members arrived they took position in front of the administration building of the shipbuilding company and were photographed by Mr. Enrique Muller, of Brooklyn, N. Y. A substantial lunch was then served in the dining rooms in the basement of the administration building, and following this the members had free run of the shipyard. The entire mechanical equipment of the plant was inspected with much care, as well as the several ships under construction on the launching ways. The special features of this shipyard were fully explained in Marine Engineering of December, 1901, in a very complete article describing this plant. The special train left Camden at about half-past 3 on its return to New York. The weather was propitious, and altogether the trip was evidently very much enjoyed by all the members.

Oil Fuel on the Kensington.—The steamship *Kensington,* of the International Navigation Company, has made a round trip from England with one of her single-end boilers equipped with oil-burning appliances of the Flannery-Boyd system. If the owners find the system successful, all the boilers of this ship and others may be equipped with it.

Turbine Steam Yacht.—On October 21 there was launched by Stephen and Sons, Linthouse, the first yacht to be fitted with turbine engines. She was christened the *Emerald* and was built to the order of Sir Christopher Furness. Her dimensions are: 236 feet in length, 28 feet 8 inches breadth, and 18 feet 6 inches depth. The intention of the designer is to obtain a speed of about 16 knots with entire absence of vibration and an exceptionally light coal consumption. The vessel has three sets of steam turbines, three shafts, and five manganese bronze propellers—one propeller on the center shaft and two each on the side shafts. All the turbines are supplied by the Parsons Marine Steam Turbine Company. The main boiler is of large diameter and is fitted with forced draft.

New Three-Masted Schooner Madeleine.

The three-masted schooner *Madeleine,* which was launched September 2, 1902, from F. S. Bowker's yard, at Phippsburg, Me., is a model for this class of vessel. She was designed by F. S. Bowker especially for the lumber trade, and great pains were taken in construction to make her an ideal schooner of this type.

The principal dimensions are as follows: Length over all, 147 feet; beam, molded, 34 feet; depth, 12 feet. The keel, which is 140 feet long, is composed of two 13-inch square timbers and a shoe 3 inches thick, making a total of 29 inches of solid rock maple and birch. These are bolted together by 1 1-4-inch wrought-iron bolts. The frames below the load-water line are yellow birch and rock maple, and, above, white oak. All frames 12 inches square, spaced 30 inches center to center. The main deck beams are 11 inches by 13 inches hard pine on every frame, except the hatch beams, which are 11 inches by 14 inches. Each beam is connected to ceiling by 9-inch hanging knees and 10-inch knees on hatch beams. These knees are bolted to the ceiling by 1-inch wrought-iron bolts.

The main deck plank is 3 1-2 by 4-inch white pine in 30-feet lengths; each seam is calked with five threads of the best oakum. The floor ceiling, which is 4 by 12-inch hard pine, is spiked and treenailed, and the ceiling from floor to hanging knee strake is 8 by 14-inch hard pine bolted with 1-inch wrought-iron bolts 2 1-2 feet apart, and scarfed with 7-8-inch iron. The hanging knee strakes are 9 inches by 14 inches, bolted with 1-inch wrought-iron bolts. The outside planking is hard pine of varying thicknesses. The garboard strakes are 6 by 14 inches, edge bolted to keel; the rest of planking on bottom is 4 inches thick and 14 inches wide, 12 inches on bilge, and 7 to 10 inches to deck.

The quarter deck is raised 4 feet above main deck and runs 8 feet forward of after house in order to take main sheet traveler. The main deck rail is a continuation of the quarter deck and is made of 6 by 14-inch hard pine with 7 feet locked scarf.

The quarters in the after cabin are finished in white wood and cypress. The commander's room is large and commodious, situated on the starboard side of the after house. Opening off the after side is the bathroom. The after cabin occupies the main part of the after house. It is furnished with quartered-oak furniture, handsomely upholstered. On the port side, leading from the after cabin, is a large guests' room, finished in white wood and cypress. The dining saloon is just forward of the after cabin. On the starboard side leading from the dining saloon is the steward's state room, while opposite is a large pantry. The second officer's state room is on the port side just forward of the pantry, leading also into the dining saloon. The forecastle, galley, and engine room occupy the forward house.

THREE-MASTED SCHOONER MADELEINE, BUILT AT PHIPPSBURG, ME.

The *Madeleine* has accommodations for four seamen, besides the master, one mate, steward, and engineer.

The engine room is very completely fitted out, contains a 42-inch vertical boiler, a Hyde windlass steam winch, and a wrecking pump. The sails are handled by leads to the catheads of the winch, which project outside of the engine room. The schooner is equipped with four stockless anchors weighing 2,300, 2,100, 600, and 300 pounds respectively. The rig is the same as usually

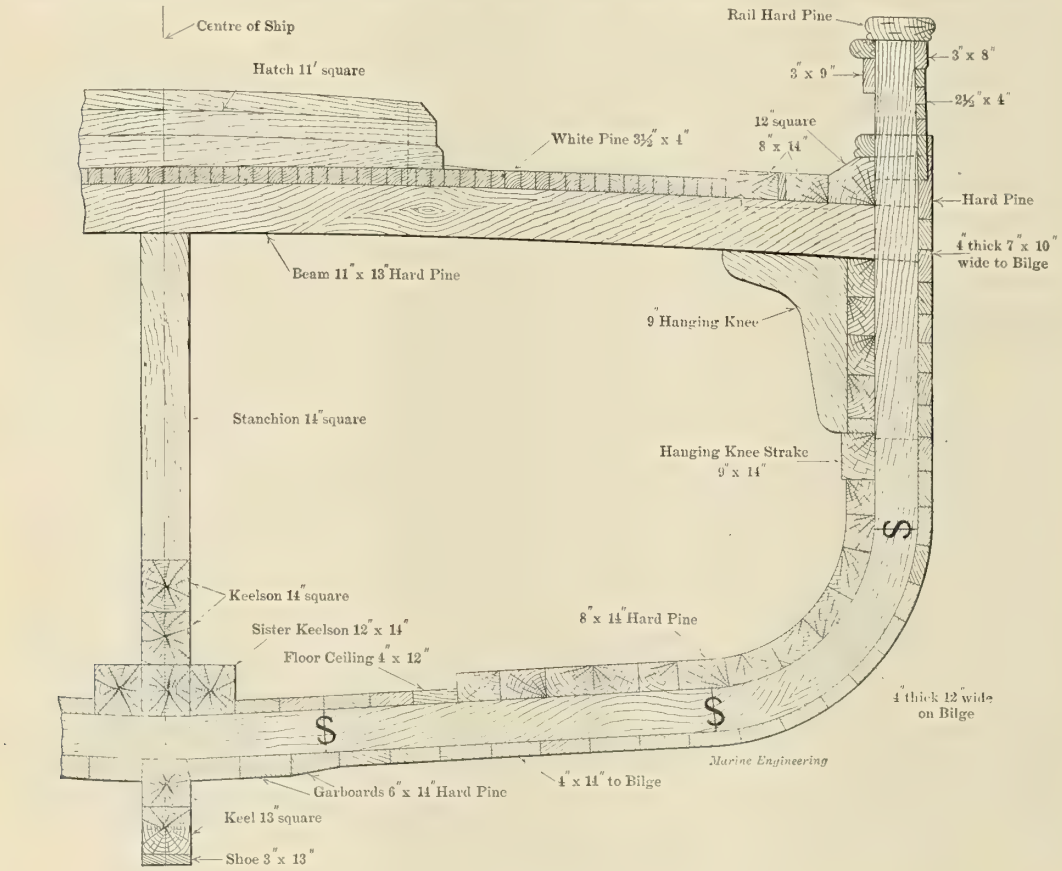
found on three-masted schooners. The total number of yards of canvas in the sails is 3,500, and all of the sails, excepting the topsails, flying jib, and outer jib (which measure 800 yards and are of No. 5 duck), are made of No. 0 duck 22 inches wide.

Old Prison Ship Jersey.—In building a section of the new ways for the construction of the battleship *Connecticut* at the Brooklyn Navy Yard, the famous English prison ship *Jersey* was discovered. At the close of the Revolution the hull of the vessel was burned, and now lies in about two fathoms of mud and water. The *Jersey* was one of six British prison ships, and the stories of hardship of the prisoners on board are most appalling. About 1,200 were confined on her constantly, and, it is estimated, 11,000 of her prisoners are buried along the Brooklyn shore. In her day she was a first-class line-of-battleship and had a crew of 400 men.

Increased Lake Fleets.—It is reported that the United States Steel Corporation proposes to build a large addition to its fleet of ore ships. Realizing the fact that the berths of the American Shipbuilding Company are all filled and were liable to be kept so, the Steel Corporation, acting through the Pittsburg Steamship Company, has secured an option on all berths to be vacated during the year 1903 at Buffalo, Cleveland, Detroit, Lorain, Chicago, and Superior. It is probable that the proposed steamers will be about 550 feet long and on the present draft have a carrying capacity of 9,000 gross tons each.

OIL-FUEL INSTALLATION ON STEAMSHIP J. M. GUFFEY.

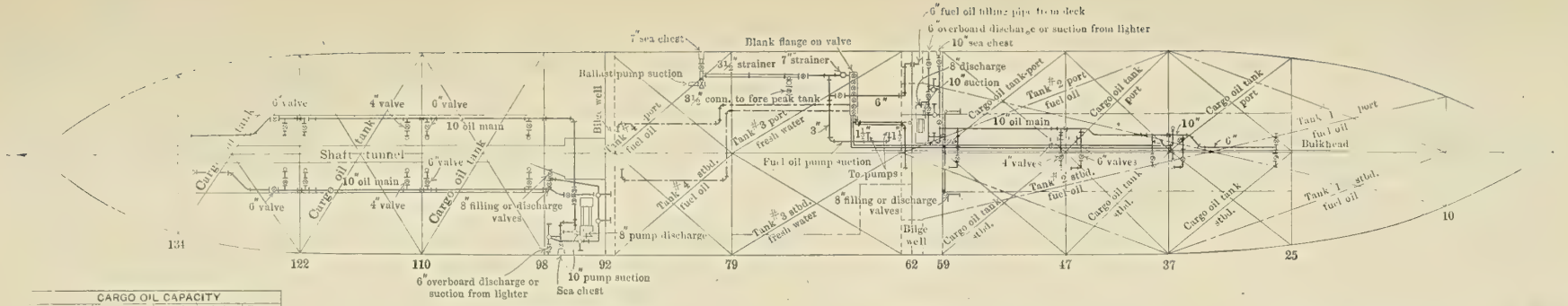
Among the most recent ships fitted for burning oil fuel is the steamship *J. M. Guffey*, of the J. M. Guffey Petroleum Company. This steamer was the first vessel built by the New York Shipbuilding Company, Camden, N. J., for the firm of Robert Dollar and Company, of San Francisco. Just prior to her completion she was bought by the J. M. Guffey Company, and arrangements were made for transforming her into a tank ship for carrying oil in bulk, and in addition to carrying oil as cargo she was fitted for burning oil as fuel.


Centre of Ship
Hatch 11′ square
Rail Hard Pine
3″ x 8″
3″ x 9″
2½″ x 4″
12″ square
8″ x 14″
White Pine 3½″ x 4″
Hard Pine
4″ thick 7″ x 10″ wide to Bilge
Beam 11″ x 13″ Hard Pine
9″ Hanging Knee
Stanchion 14″ square
Hanging Knee Strake 9″ x 14″
Keelson 14″ square
Sister Keelson 12″ x 14″
Floor Ceiling 4″ x 12″
8″ x 14″ Hard Pine
4″ thick 12″ wide on Bilge
Marine Engineering
4″ x 14″ to Bilge
Garboards 6″ x 14″ Hard Pine
Keel 13″ square
Shoe 3″ x 13″

MIDSHIP SECTION OF THREE-MASTED SCHOONER.

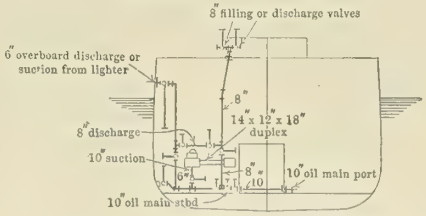
The ship as first constructed, and its machinery, were fully described in the August number of MARINE ENGINEERING, 1901, and it is the object of this article to give a brief description of the ship in its present condition and the method employed for burning oil as fuel, which has demonstrated itself to be perfectly satisfactory after several months' service between the ports of New York and Port Arthur, Texas. For the sake of comparison a few of the principal items of the machinery will also be mentioned.

As shown by the accompanying plans, the steamer is 300 feet in length between perpendiculars, 40 feet beam, 21 feet loaded draft, and has a load displacement of 5,675 tons when carrying 945,500 gallons of oil. She is fitted with six tanks, as shown on plans, three forward and three aft, the forward tanks being arranged with a centerline bulkhead extending from the forward cargo

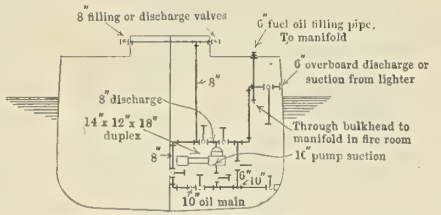


CARGO OIL CAPACITY				
		Cu. ft.	Gal.	Tons.
Tank No. 1		21480	160670	549.3
" " 2	Excluding	18564	138858	474.7
" " 3		22144	165640	566.3
" " 4	Trunks	21446	160416	548.4
" " 5		20527	153540	525.0
" " 6		10160	120877	413.3
	Total	120321	900000	3077.0

FUEL OIL CAPACITY			
	Cu. ft.	Gal.	Tons.
Double bottom #1	4557	34086	116.5
" " #2	5661	42341	144.8
" " #4	3018	22572	77.2
Total	13236	99000	338.5


8" filling or discharge valves
6" overboard discharge or suction from lighter
8" discharge
14" x 12" x 18" duplex
10" suction
8" 10"
10" oil main port
10" oil main stbd

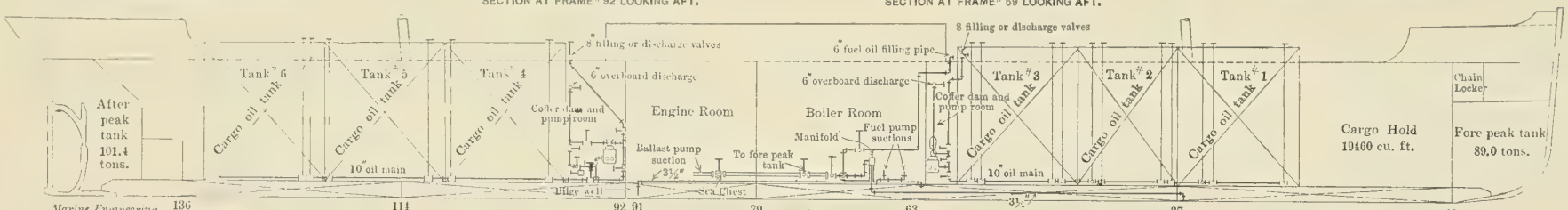
SECTION AT FRAME #92 LOOKING AFT.


8" filling or discharge valves
6" fuel oil filling pipe, To manifold
6" overboard discharge or suction from lighter
8" discharge
14" x 12" x 18" duplex
Through bulkhead to manifold in fire room
10" pump suction
10" oil main

SECTION AT FRAME #59 LOOKING AFT.

WATER BALLAST	
	Tons.
Fore peak	89.0
Double bottom #5	134.8
" " #6	60.5
" " #3 (fresh)	107.6
After peak	101.4
Total	493.3

HOLD CAPACITY	
Hold	19460 cu. ft.



Tank #6, ballast. Capacity for both stbd. and port tanks = 60.5 tons

Tank #5, ballast. Capacity for both stbd. and port tanks = 134.8 tons

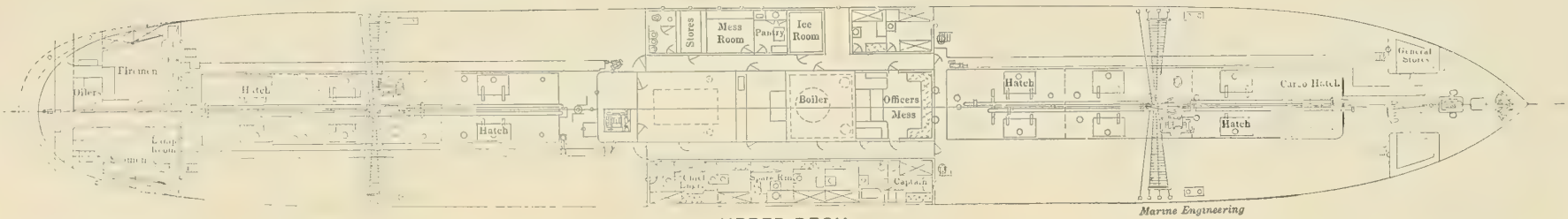
Tank #4, fuel oil.

Tank #3, fresh water. Capacity for both stbd. and port tanks = 107.6 tons

Tank #2, fuel oil.

Tank #1, fuel oil.

Cargo oil pipes indicated by ———
Fuel " " " "



UPPER DECK

DECK PLANS AND SECTIONS SHOWING ARRANGEMENT OF CARGO, OIL TANKS, AND FUEL OIL SYSTEM ON THE TANK STEAMER J. M. GUFFEY, BUILT BY THE NEW YORK SHIPBUILDING COMPANY, CAMDEN, N. J.

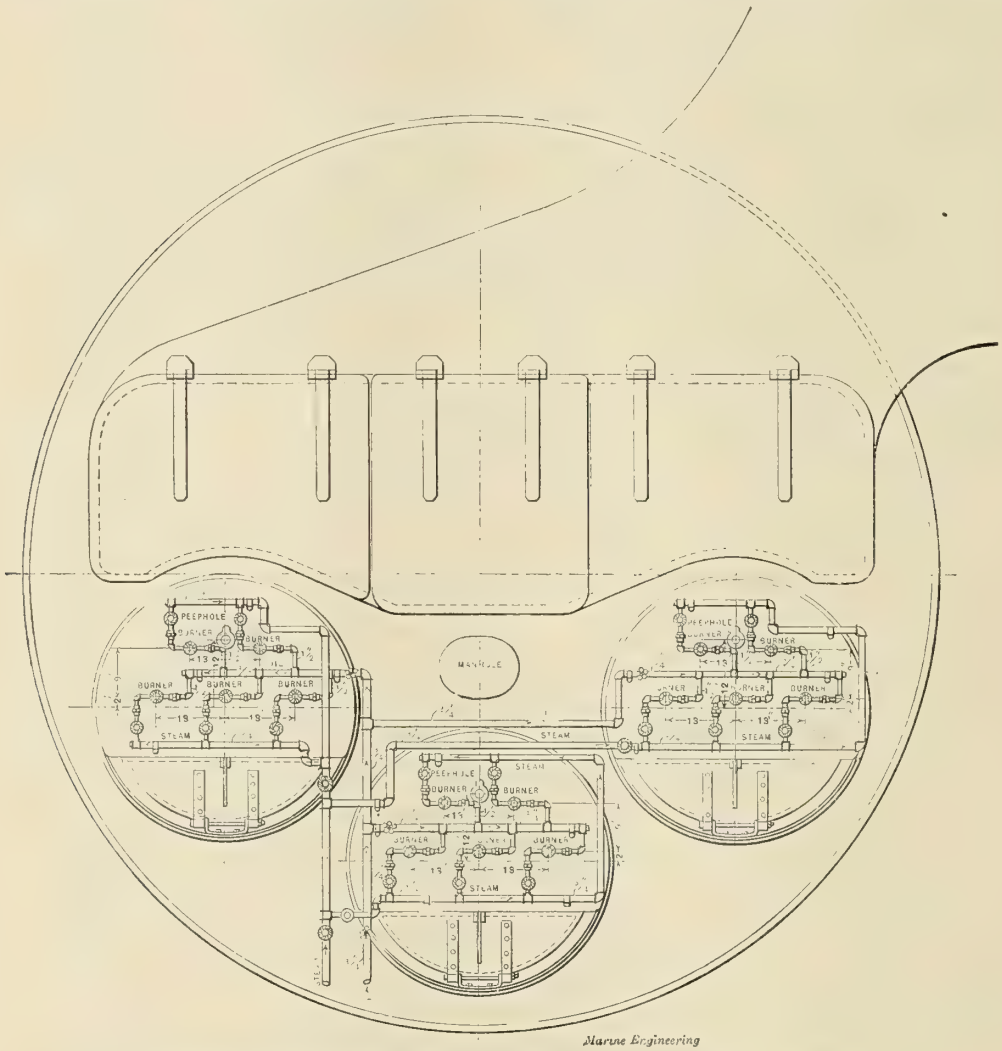
hold to the boiler-room bulkhead, while the after tanks run clear across the ship and are divided in the fore-and-aft direction by the shaft tunnel running through them.

The main engines are of the vertical triple-expansion type, with cylinders 22, 36, and 59 inches in diameter, all having a common stroke of 42 inches and driving a single screw of 13 feet in diameter by 16 feet pitch. There are two main boilers, each 14 feet diameter by 12 feet 2 inches long, with three furnaces 46 inches diameter. The total heating surface is 4,212 square feet.

The auxiliary machinery consists of—

One main feed pump, 8 by 5 by 12 inches, duplex,
One auxiliary feed and fire pump of the same type and size,
One ballast pump in engine room, 12 by 14 by 12 inches, duplex,
One water service and sanitary pump, 7 by 4 1-2 by 10 inches,
One circulating pump, centrifugal type, 10 inches, with 9 by 9-inch engine,
One 7 by 7-inch steering engine,
One 10-K.W. dynamo, with 6 by 6-inch engine,
One 12 by 12-inch towing engine, and
Two cargo-oil pumps, 14 by 12 by 18 inches, duplex.

The original arrangement of the ship made it necessary to provide two independent pumping systems for handling the oil cargo in the forward and after tanks of the ship, and by utilizing the space of the cofferdams two pump rooms, one just forward of the fire room and another just aft of the engine room, were installed. Each pump room is fitted with a powerful horizontal duplex Blake pump, as above specified, having a 10-inch suction and 8-inch discharge, capable of discharging the ship's load in less than ten hours.

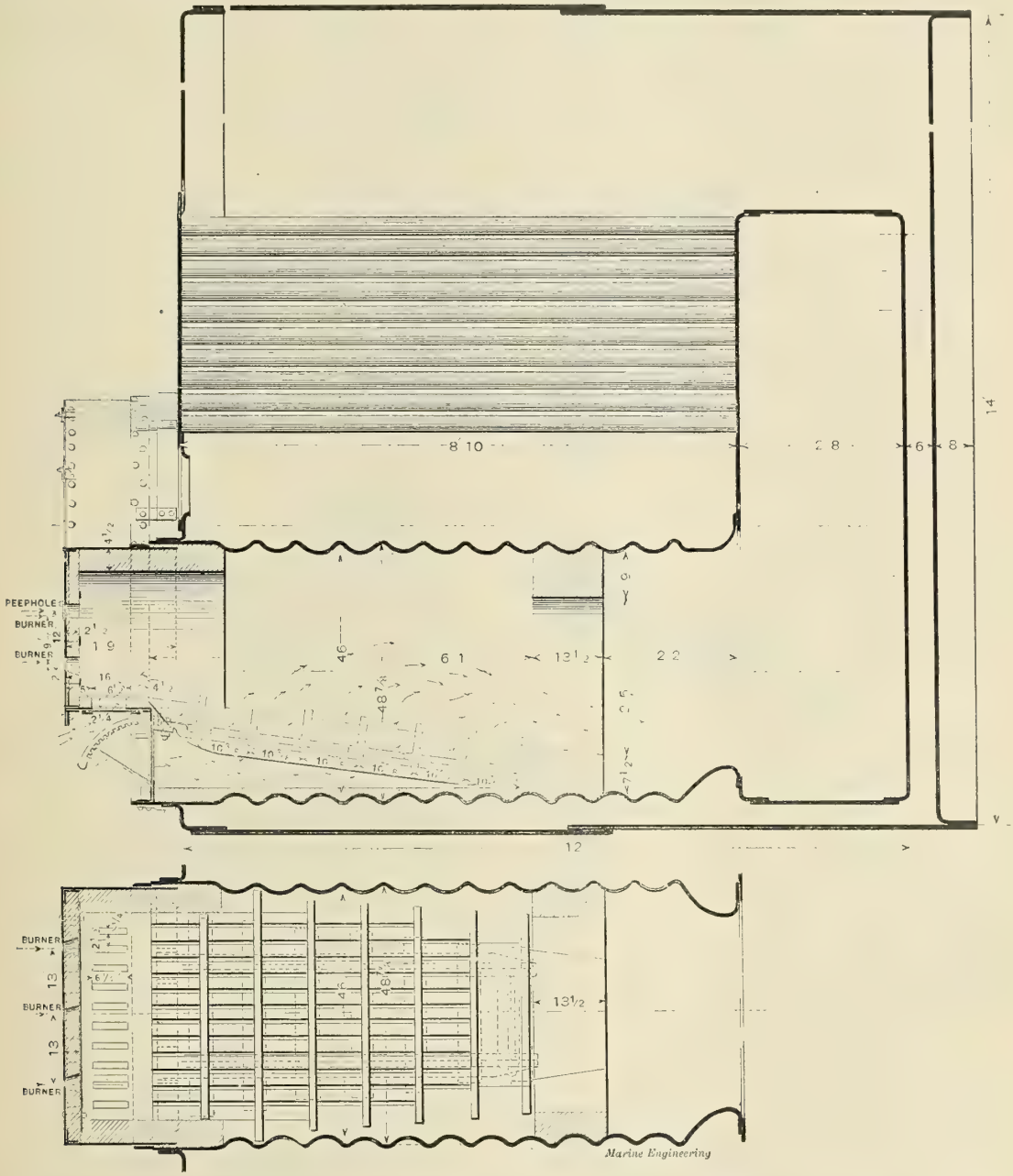


ARRANGEMENT OF OIL AND STEAM PIPING ON THE BOILERS OF THE J. M. GUFFEY.

The arrangement of the piping enables the pumps not only to discharge the cargo, but also to load the ship by drawing the oil either from lighters alongside or from tanks ashore and discharging it into any of the ship's tanks through the oil main. Should it ever become desirable to transfer the oil from one tank into another this also may be done by proper manipulation. This same pumping system is used for ballasting the cargo tanks from the sea for the return trip, when no oil or other cargo is carried, as the original ballast tanks in the inner bottom are used for carrying fuel oil for the

boilers. The total capacity of fuel-oil tanks is about 332 tons and is ample to run the vessel for a round trip between New York and Port Arthur, Texas.

There are two pumps for delivering the oil from the bunkers to the burners, only one of which is operated at a time, the other being held in reserve. One of these pumps is shown in the cut on page 636. The vertical pipe in the middle front connects the pump with the oil bunkers. The delivery of the oil is, first, into the cylindrical heating chamber forming a part of the pump foundation. From the heating chamber it is conveyed directly to the burners through the pipe shown on the lower right side. The exhaust steam from the pump enters the heating chamber at the upper left side and passes out directly below. In this manner the oil is heated to a temperature somewhat less than the temperature of the exhaust steam. The pump pressure put upon the oil in the heating chamber is about 50 pounds and is automatically regulated by a pop valve located on the opposite side of the pump, which returns the surplus discharge to the pump suction.

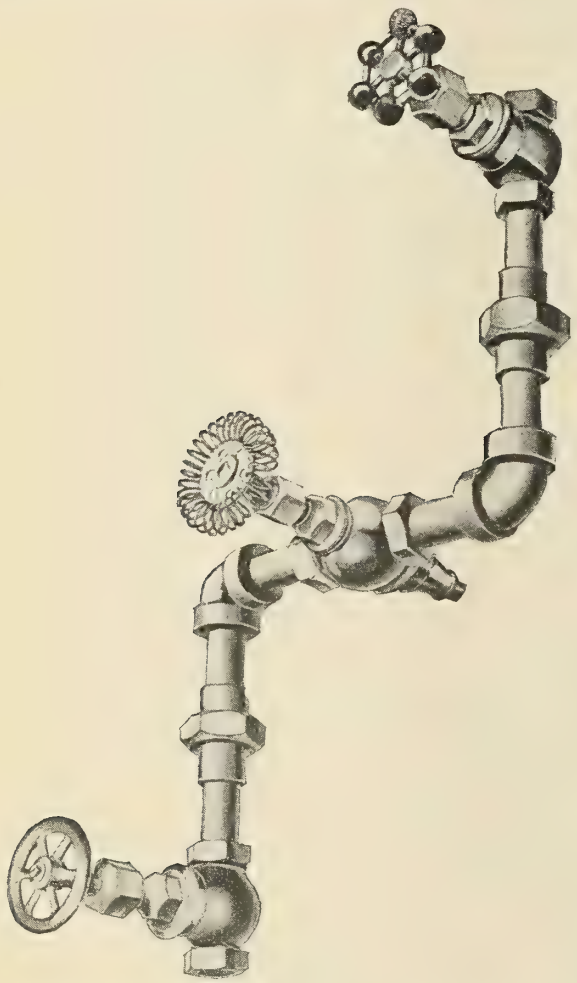


SECTION OF BOILER AND PLAN OF FURNACE ON THE J. M. GUFFEY, SHOWING THE ROCKWELL SYSTEM OF OIL BURNING.

On pages 634, 636 are shown the burners and pipe connections on the front of one of the two boilers. There are five burners in each of the three furnaces. The atomization of the oil through the burners is by steam at 80 pounds pressure. The diameter of the steam nozzle is 1-4 inch. The diameter of the oil nozzle is 3-32 inch and it is situated centrally in the

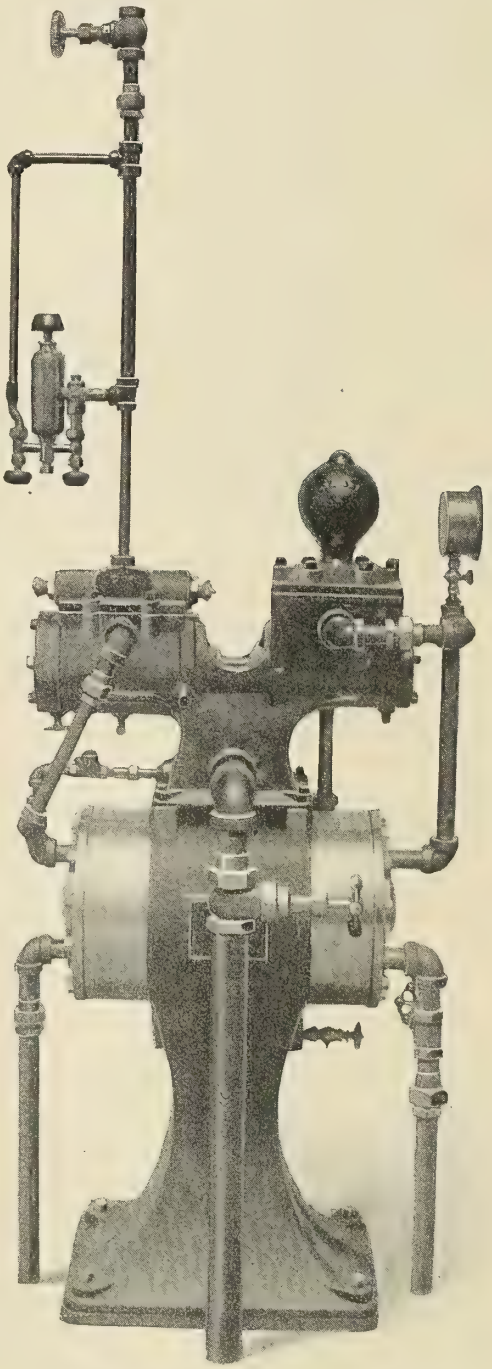
steam nozzle, forming an annular steam opening about 1-16 inch wide. In this manner perfect atomization is effected with the smallest expenditure of steam, and combustion begins within the extension hoods, not at the rear of the furnaces. Natural draft supplies the air for combustion. The air in passing through the highly-heated brick-lined hoods, or through the inclined brickwork forming the bottoms of the furnace chambers, is divided and heated before coming in contact with the thoroughly vaporized oil, and rapid and clean combustion is the result.

The absence of compressed-air and fan blowers leaves the equipment exceedingly simple, saves room, and saves cost.



THE ROCKWELL OIL BURNER INSTALLED ON THE J. M. GUFFEY.

The boiler section herewith, page 635, shows clearly the firebrick construction of the furnaces. In order to secure complete combustion of the oil vapors as discharged from the burners, it is absolutely necessary that the temperature of the furnace be maintained at a high degree near the front, where the oil enters; therefore the brick-lined chambers or hoods at the front of each furnace. Part of the air to support combustion is drawn in through the adjustable openings at the bottom of these hoods, and part through the inclined brick bottoms, the latter acting in the capacity of a bed of coals to heat the air as it passes through. A Scotch marine boiler of average length is a short boiler in which to burn oil. Its furnace and combustion chambers, unaided by firebrick, are poor supporters of combustion of oil vapors, however good heating surfaces they may be for coal fuel. The oil engineer must choose between heating surface and radiating surface. The inclined bottom in this setting insures an entrance of air throughout its length, so that the air is divided and heated, while it increases the heating surface over that of the ordinary coal-grate setting and causes a higher temperature in the rear bottom. The arch sprung over



OIL PUMP AND HEATER ON THE J. M. GUFFEY.

the bridge wall serves both to intensify the combustion and to retard the gases, so that there is no impinging effect upon the back plates and staybolts. The *Guffey* has now been burning oil about five months, and her staybolts and flue beads show no signs of injury. Her flues are always clean, and smoke seldom, if ever, shows at her stack.

The furnace fronts can be easily removed for inspecting the boiler whenever necessary, all parts are easily accessible, the position of the firebrick work makes it durable, and the furnace castings cannot burn out.

The prevailing idea in this system is to thoroughly atomize the oil and to intermix it with the heated air of the furnace, which is the only successful method for complete combustion. The proof of the fact is the clean plates, flues, and brickwork in the *Guffey's* boilers after five months' firing.

For starting the fires in the main boilers an upright 15-horse-power donkey boiler of the Lidgerwood type is installed, and this boiler furnishes steam for the pumps and the burners until sufficient steam is raised in the main boilers to supply the system.

No exact data are available at present, but on one run of 119 hours the boilers consumed 34,000 gallons of oil, running at about 1,650 I.H.P. This, as will be seen, gives a result of about 1.32 pounds of oil per I.H.P. per hour, *including all auxiliary machinery.* The oil weighs 7.65 pounds per gallon.

Steamship Korea.—The new steamship *Korea,* belonging to the Pacific Mail Steamship Company, on her first homeward voyage from Yokohama to San Francisco lowered the best record heretofore existing by two days, making the trip in ten days and fifteen hours.

Cup Syndicate.—The New York Yacht Club has accepted the challenge of Sir Thomas Lipton for the America's Cup, and it is announced that the new cup defender will be owned by a syndicate composed of the following men: Elbert H. Gary, Clement A. Griscom, James J. Hill, William B. Leeds, Norman B. Ream, William Rockefeller, Cornelius Vanderbilt, Henry Walters, and P. A. B. Widener.

In Honor of John Fritz.—A most memorable meeting of four hundred distinguished men interested directly and indirectly in the steel and iron industry took place at the Waldorf-Astoria on November 1 to do honor to John Fritz, the oldest steel master in the country. The John Fritz gold medal for achievement in the industrial sciences was founded, to be awarded only by a committee of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of London Engineers, and the American Institute of Electrical Engineers. The medal was designed by the American sculptor, Victor B. Brenner, and bears the head of John Fritz. Mr. Fritz was given the first medal on this occasion, which was his eightieth birthday. He is a native of Pennsylvania, and after a common-school education he began life as a blacksmith, and has since been connected with almost every important step in the iron and steel industries, his principal work being the care of the forge and armor-plate plant of the Bethlehem Steel Company.

Steamer Queen Caroline.

The Queen Anne Ferry and Equipment Company's new passenger steamer *Queen Caroline* was designed and built by the Baltimore Shipbuilding and Dry-dock Company, Baltimore, Md., for service between Cape May, N. J., and Lewes, Del. The contract for the construction of the new steamer was signed November 1, 1901, and stipulated a speed of 16 miles per hour and delivery not later than July 1, 1902. Work was begun on the new boat without delay, and the first section of keel was laid on December 9. She was launched May 13, 1902, and had her first dock trial June 27. Two days later all the finishing touches were completed, and on the morning of July 1 she left the works for a trial trip to Love Point, on the Chesapeake Bay. This trial showed that the boat fulfilled all the requirements.

The new vessel is a fine specimen of a modern excursion steamer of the single-screw type. Her hull is of open-hearth steel and has the following dimensions:

Length between perpendiculars	187 ft. 0 in.
Length over all	200 ft. 0 in.
Beam, molded	31 ft. 0 in.
Depth at lowest point of sheer	13 ft. 3 in.
Mean load draft	7 ft. 9 in.
Corresponding displacement	640 tons.

There are three decks and five transverse bulkheads; four of the bulkheads are water-tight. The main saloon is on the promenade deck and has a dome skylight extending the full length, which furnishes ample light and ventilation. The saloon is finished in white, touched up with gold, giving a handsome effect. On the promenade deck are also located seven state rooms and the ladies' toilet room. The main stairway on this deck is of artistic design, constructed of hard wood. The dining saloon, social hall, news stand, and purser's office are located aft on main deck. The gentlemen's toilet and engineers' rooms are also located on this deck abreast of the engine space, and the forward part of this deck is reserved for freight and has a capacity of 100 tons. The captain's and mate's quarters are located on the hurricane deck just aft of the pilot house. The crew's quarters and the bar are below the main deck, forward. The galley, pantry, and refrigerator room are located below the main deck, aft.

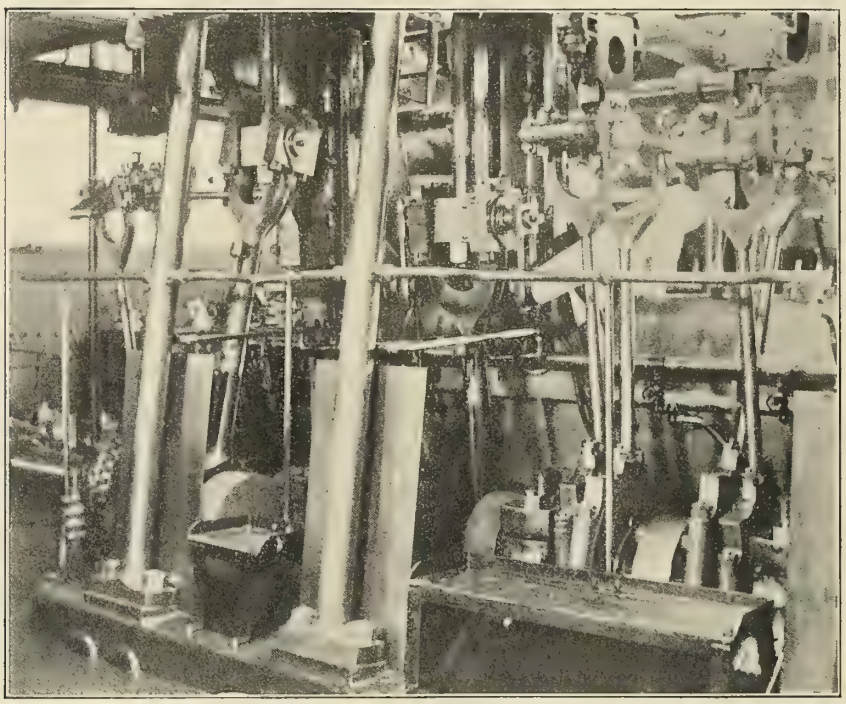
The propelling machinery develops 1,000 I.H.P. and consists of a fore-and-aft triple-expansion engine with cylinders 16, 25, and 42 inches diameter and a common stroke of 30 inches. The high and intermediate cylinders are fitted with piston valves, one to the former and two to the latter. The low-pressure cylinder has a double slide valve with a balance cylinder. The valves are worked by the Stephenson's gear, which is, with the throttle valve, controlled from a working platform situated below the engine-room grating. The condenser forms a part of the engine housing and contains 1,466 square feet of cooling surface. The air pump together with two bilge pumps are worked from the intermediate crosshead. The crank shaft is of the built-up type and measures 8 1-4 inches diameter.

There is a cast-iron, four-bladed, solid type propeller, 8 feet 6 inches diameter. The leading edges of the blades are skewed forward, beginning at hub and gradually decreasing toward the tips. The tips of the blades are raked back 5 inches. Steam is supplied by

four main boilers, single-end Scotch type, and one vertical donkey boiler. The former were tested for 180 pounds and the latter for 110 pounds working pressure.

tal duplex type and of the Blake manufacture. The electric-light plant, with capacity for supplying 600 lights of 16 C. P. and 110 volts, is of the General Electric Com-

MAIN SALOON, LOOKING FORWARD, ON THE STEAMER QUEEN CAROLINE.



MAIN ENGINE OF THE QUEEN CAROLINE, BUILT BY THE BALTIMORE SHIPBUILDING AND DRY-DOCK COMPANY.

The total grate surface in the main boilers is 120 square feet and the heating surface 3,026 square feet, giving a ratio of 1 to 25. The circulating pump and engine were made by the Kingsford Foundry and Machine Company.

The fire, feed, and sanitary pumps are of the horizon-

pany's make; it is located in the engine room on the starboard side near the after bulkhead, on which is located the main switchboard. Two small panel switches are located in the main saloon on the after ends of stateroom tiers. Of the 300 lights distributed over the vessel,

several are grouped into clusters in the main saloon and dining hall.

The *Queen Caroline* was the first boat built by the Baltimore Shipbuilding and Dry-dock Company, which is the successor to the Columbia Iron Works. The site is adjacent to the historic Fort McHenry on Locust Point, at the entrance to Baltimore harbor, well located and convenient to shipping and railroads. Extensive improvements are being made and much machinery is being installed to make this plant up-to-date. The company has lately rebuilt the steamer *Hero* and is now building two large steel barges.

Oil Burning with Induced Draft.

A test of a Scotch boiler equipped with Ellis and Eaves system of induced draft was recently attended by a number of engineers at Sheffield, England, where an evaporation of 16.1 pounds from and at 212 degrees was attained per pound of oil. The dimensions of the boiler are: Diameter, 12 feet; length, 11 feet; inside diameter of the two Purves furnaces, 3 feet 9 inches. It is fitted with 148 Serve tubes 3 1-4 inches diameter by 7 feet 9 inches long. Total heating surface is 12,000 square feet, and for coal burning the grate surface would be 43 square feet.

The oil was supplied to each furnace by Rusden and Eeles burners, the jet of flame impinging against the brick pillar and thence diffusing throughout the body of the brick-lined furnace tube. The feed water was taken from two measuring tanks, and oil was measured in two similar tanks and supplied at 75 degrees F.

The induced draft equipment consisted of an air-heating box, through which the gases from the furnace passed on their way to the fan. Fresh air is taken into this box around tubes, where it is heated to about 360 degrees F., and led down and into the furnaces. By regulating the fan and the burners the boiler is easily controlled for working under a light or heavy load.

The six-hour test gave the following results:

Water evaporated per hour, actual.....10,891 lbs.
" " " " from and at 212 degrees F.....13,145 "
Water evaporated per pound of oil, actual....13.4 "
" " " " " from and at 212 degrees F.....16.1 "
Water evaporated per sq. ft. of H.S., actual... 9 "
" " " " " " from and at 212 degrees F.....10.9 "

Theoretical heating of the oil burners will give an equivalent evaporation of 212 degrees F. of 19.14 pounds, showing the efficiency of the boiler to be 84 per cent. No smoke was emitted from the chimney during this test, and in three hours' subsequent test, which was to ascertain the maximum evaporation possible in such a boiler with oil fuel without producing smoke, a total of 18,900 pounds from and at 212 degrees was evaporated per hour. In this test the evaporation per pound of combustible was slightly reduced—namely, to 15.8 pounds. The oil used was from the Beaumont field and has a heating value of 18,450 B.T.U.

The tests show how high the ordinary marine type of boiler may be forced and still be efficient by the use of oil fuel, an amount of steam equivalent to 1,200 I.H.P. being generated in this size boiler.

ANNUAL REPORT OF THE CHIEF OF THE BUREAU OF STEAM ENGINEERING.

TRIALS OF THE HOHENSTEIN BOILER.

In the annual report of Rear Admiral George W. Melville, Chief of the Bureau of Steam Engineering, is contained the report of a board appointed to conduct a series of tests on the Hohenstein marine boiler. The boiler was built by the Oil City Boiler Works Company, of Oil City, Pa., to conform with the specifications for the cruiser *Denver*. The boiler was erected in an air-tight steel house, the dimensions of this house approximating to one of the fire rooms of the *Denver*. The headers of the boiler are made of wrought steel, and the tubes are arranged in pairs in such a way that each tube is free to expand independently of the others, thus effectually preventing longitudinal stresses in them. On page 642 is given a longitudinal section boiler, and it is to be noted that the down-flow takes place within tubes which are located in a comparatively cool place, while on the other hand there is invariably an upward trend to the current in all tubes and heaters exposed to the hot gases. It is, therefore, probable that there are no reverse currents in any part of the water circuit. The feed water is introduced at the top of the down-take tubes, which is obviously the best place with regard to the influence of the circuit.

The structure in which the boiler was mounted is air-tight, and the auxiliary machinery, together with the apparatus for making observations and measurements, was mostly placed in an adjoining structure. For forced draft a fan 72 inches in diameter, with a discharge 20 by 42 inches, was run by a separate steam engine. The pipe connections were such that steam from the auxiliaries could be taken either from a small upright boiler or from the main boiler. The feed water was weighed in two tanks, each of 1,000 tons capacity, and heated by a steam coil. The coal was weighed in sheet-metal cans or bags, the method being to adjust each can or bag to a uniform weight of 220 pounds. The ashes and refuse were also weighed. The quality of the steam was determined by means of a Barrus throttling calorimeter, and analyses of the flue gases were regularly made by using an Orsat apparatus, upon samples drawn from the center of the stack. During each test samples of the coal used were set aside for determining moisture and other analyses.

The first six tests were run by a crew of firemen experienced in torpedo-boat work, but the remaining eleven were made by firemen who had never before fired a boiler under forced-draft conditions.

Careful examination of the boiler after each of the tests showed no distortion of the tubes, nor any damage to the boiler. The boiler was given very hard work, but in the severe trials showed no indication of injury. No leak developed and not a tube bent. The tubes were frequently examined, and they were clear from mud, showing that a good circulation had been maintained.

The board, which was composed of the three Lieutenant-Commanders, John R. Edwards, Wythe M. Parks, and Frank H. Bailey, recommended that, in order to assist in discovering an approved type to meet the requirements of the navy, the Hohenstein boiler be installed on an American warship.

A summary of results is as follows:

Number of trial.	Date of trial.	Duration of trial (hours).	Kind of fuel (P., Pocahontas coal; N. R., New River coal; r. m., run of mine; h. p. s., hand picked and screened).	State of weather.	Height of barometer at noon.	Steam pressure by gage; corrected for water level, pounds per square inch.	Revolutions of blower per minute.	Average temperature.					Fuel.	
								External air (Deg. F.).	Air in fire room (Deg. F.).	Chimney gases (Deg. F.).	Feed water entering boiler (Deg. F.).	Steam at gage pressure (7) from steam tables (Deg. F.).	Weight of wood used in starting fire (pounds).	Weight of coal used in starting fire (pounds).
1	2	3	4	5	6	7	15	16	17	18	19	20	21	22
	1891.													
1....	April 23	8	P., r. m.....	Clear.....	30.02	263.9	0	57.2	93.8	594	144	410.4	350	2,400
2....	April 26	6	"	Dull and overcast.....	30.12	272.9	250	70.3	117 8	751	145.4	413.3	300	2,000
3....	May 8	4	"	"	29.86	274.6	335	72.8	121 7	1,089	145 8	413.7	390	2,500
4....	May 29	8	"	Squally.....	29.70	271.3	0	64.4	114	688	137	412.7	340	2,000
5....	June 5	6	"	Bright and sunshiny.....	30.08	272.5	243	84.1	139.5	712	129.3	413.1	360	2 200
6....	June 8	3½	"	"	29.95	270.5	375	74.8	127 3	1,105	116.5	412.5	(?)	(?)
7....	Oct. 21	8	N. R., r. m..	Clear.....	30.34	273.5	0	71 3	144	563	131.8	413.6	360	2,000
8....	Oct. 23	6	" ..	Cloudy	29.95	273.5	243	74.3	124	654	126.1	413.6	250	1,910
9....	Oct. 26	4	" ..	Smoky.....	30.25	273.5	375	68	106.5	688	111.8	413.6	361	2,200
10....	Nov. 6	8	P., h. p. s....	Clear and damp.....	30.20	273.5	0	62.7	125	548	125.9	413.6	350	2.792
11....	Nov. 9	8	"	Cloudy, occasional sun ...	30.18	273.5	0	55.1	125.4	521	122.3	413.6	350	1,435
12....	Nov. 18	6	"	Gray and overcast.....	30.09	273.5	240	52	105	580	119.7	413.6	350	2,762
13....	Nov. 27	4	"	Thin clouds.....	30.23	273.5	375	40.2	86	717	91.4	413.6	310	2.762
14....	Dec. 16	6	"	Smoky, with thin clouds .	30.13	273.5	243	32.3	77	766	104.6	413.6	350	3,256
15....	Dec. 18	8	"	" ..	30.01	273.5	0	26	87	568	125	413.6	360	2,440
16....	Dec. 21	4	"	Smoky, no clouds.....	30.28	273.5	332	22	64	800	98 4	413.6	450	3,130
	1892.													
17....	Jan. 11	3	"	Dark, fog and smoke.....	29.58	273.5	423	35.4	76.5	943	88	413.6	350	3,554

Number of trial.	Approximate fire-room air-pressure.	Fuel.											Steam.	Water.			
		Weight of coal used during test (pounds).	Total weight of fuel used (pounds), (21) + (22) + (23).	Weight of ashes before beginning test (pounds).	Weight of ashes during test (pounds).	Weight of refuse from furnace, tubes, baffles, etc. (pounds).	Total weight of ashes and refuse (pounds), (25) + (26) + (27).	Percentage of ashes and refuse, (28) ÷ (24) × (100).	Weight of ashes and refuse from coal used during test (pounds), (23) × (29) ÷ 100).	Percentage of moisture in coal (*by weighing and drying sample; †by chemical analysis.)	Weight of moisture in coal used during test (pounds), (23) × (31) ÷ 100.	Weight of dry coal burned during test (pounds), (23) − (32).	Weight of combustible burned during test (pounds), (33) − (30).	Quality of steam.	Total weight of water fed to boiler (pounds), (corrected for inequality of water level and steam pressure at beginning and end of test).	Equivalent weight of water evaporated into dry steam (pounds), (37) × (35).	Factor of evaporation (H − h) ÷ 965.7.	Equivalent weight of water evaporated into dry steam from and at 212° F. (pounds), (38) × (39).
1	8	23	24	25	26	27	28	29	30	31	32	33	34	35	37	38	39	40
1....	0	9,720	12,470	260	377	640	1,277	10.24	995	*0.50	49	9.761	8,676	0.980	76,016	74.555	1.134	84.430
2....	1	10,445	12,745	160	575	550	1,285	10.08	1,053	* .50	52	10,393	9,340	.968	86,673	81,260	1.133	92,060
3....	2	10,569	13,459	195	459	815	1,469	10.91	1,153	* .50	53	10,516	9,363	.989	79 803	78,700	1.133	89,170
4....	0	8,633	10 973	175	226	549	950	8.66	747	† .79	68	8,565	7,818	.990	77.953	77,120	1.142	88,070
5....	1	10,695	13,255	200	1,038	539	1,777	13.40	1,432	† .79	85	10,610	9,178	.988	92,458	91,300	1.150	104.740
6....	2	8 461	8,461	(?)	591	626	1,217	14.37	1,216	† .79	67	8,394	7,178	.990	60,539	59.800	1 163	69.540
7....	0	8,056	10,416	198	485	561	1,244	11.95	963	*3.14	253	7,803	840	.986	68.415	67,450	1 147	77,360
8....	1	9,698	11,858	161	365	528	1,054	8.89	862	*3.14	304	9.394	8.532	.976	80,747	78,800	1.153	90,950
9....	2	9,000	11,561	152	391	732	1.275	11.03	993	*3.14	283	8,717	7 724	.980	71,644	70,200	1.169	82.070
10....	0	8,299	11,441	225	214	526	965	8.44	700	*2.04	169	8,130	7 430	.988	70,148	69.300	1.154	79.980
11....	0	7,436	9,221	303	584	356	1,243	13.48	1.003	*1.15	85	7,351	6,348	.987	65 430	64,570	1.157	74,710
12....	1	8,388	11.500	526	837	562	1,925	16.75	1,405	*1.59	134	8,254	6.849	.983	70.273	69,070	1.159	80.060
13....	2	10,694	13,766	267	460	936	1,663	12.08	1,292	*1	107	10,587	9 295	.979	86,194	84.370	1.189	100.320
14....	1	14 029	17.635	271	714	923	1,908	10 82	1,518	† .73	102	13.927	12.409	.980	108.763	106,580	1.176	125,350
15....	0	9,181	11 981	235	702	576	1,513	12.63	1,160	† .73	67	9,114	7,954	.985	81,018	79 790	1.155	92.160
16....	2	12,612	16,192	105	646	895	1,646	10 18	1,285	† .73	92	12 520	11,235	.978	92,423	90.390	1.182	106,840
17....	3	10,862	14 766	151	254	1,355	1,760	11.92	1,295	† .73	79	10,783	9,488	.974	77,857	75,820	1.193	90,450

SUMMARY OF SEVENTEEN TESTS OF THE HOHENSTEIN

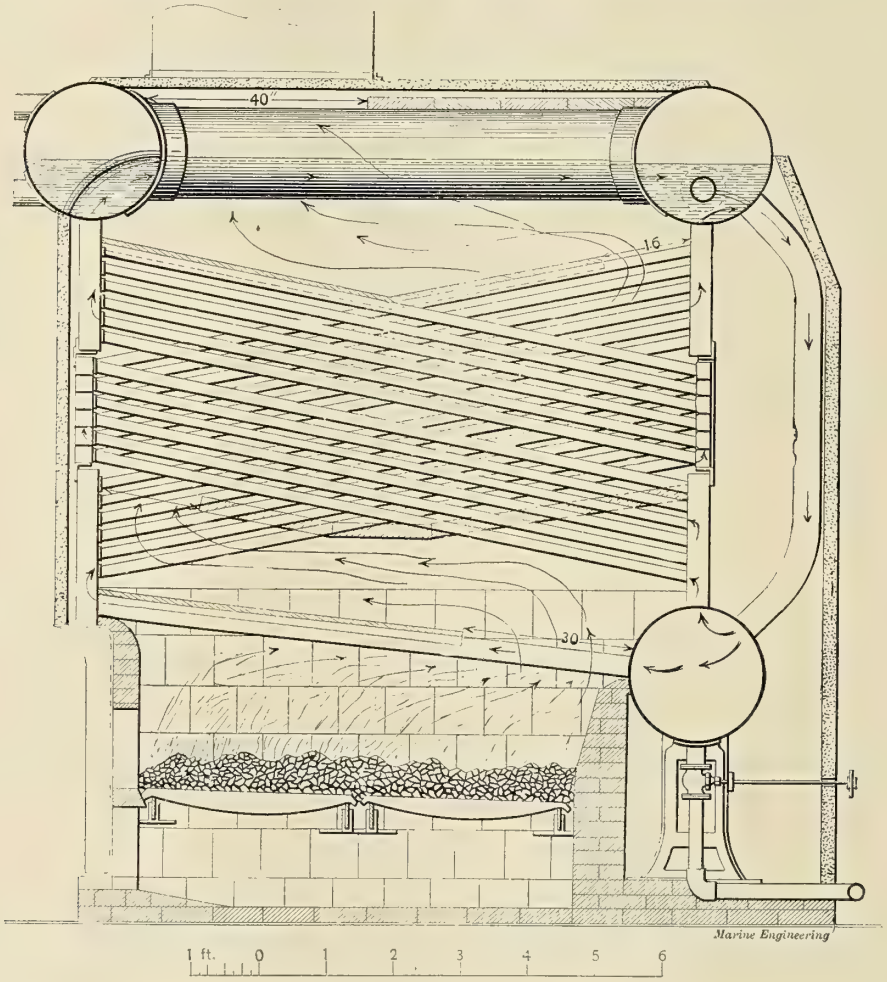
Number of trial.	Approximate fire-room air-pressure.	Economic results.				Fuel per hour.				Water per hour.				Chimney gas analysis.			
		Feed water per pound of coal as fired (pounds), (37) ÷ (23).	Equivalent evaporation from and at 212° F. per pound of coal as fired (pounds), (40) ÷ (23)	Equivalent evaporation from and at 212° F. per pound of dry coal (pounds). (40) ÷ (33).	Equivalent evaporation from and at 212° F. per pound of combustible (pounds), (40) ÷ (34).	Coal as fired per hour (pounds), (23) ÷ (3).	Dry coal per hour (pounds), (33) ÷ (3).	Combustible per hour (pounds), (34) ÷ (3).	Coal as fired per hour per square foot of grate (pounds), (45) ÷ 50.14.	Feed water per hour (pounds), (37) ÷ (3).	Equivalent evaporation from and at 212° F. per hour (pounds), (40) ÷ (3).	Equivalent evaporation from and at 212° F. per hour per square foot of grate (pounds), (53) ÷ 50.14.	Equivalent evaporation from and at 212° F. per hour per square foot of heating surface (pounds), (53) ÷ heating surface.	Carbonic acid CO_2 (per cent.).	Oxygen, O (per cent.).	Carbonic oxide, CO (per cent.).	Nitrogen, N (per cent. by difference).
1	8	41	42	43	44	45	46	47	48	51	53	54	55	56	57	58	59
1....	0	7.82	8.69	8.73	9.74	1 215	1,209	1,085	24.2	9,502	10,554	210	4.85	9.85	6.85	1.67	81.63
2....	1	8.30	8.81	8 86	9.86	1,741	1,732	1,557	34.7	14,446	15,343	306	7.05	9.46	6 50	1.96	82.08
3....	2	7.55	8.44	8.48	9.52	2.642	2,629	2,341	52.6	19,951	22,292	445	10.25	12.42	4 85	1	81 73
4....	0	9.03	10.20	10.28	11.26	1.679	1,071	977	21.5	9,744	11,009	219	5.06	11.08	4.75	2.19	81.98
5....	1	8.65	9 79	9.87	11.41	1,782	1,769	1,530	35.5	15,410	17,457	348	8.03	10.35	5.03	2.20	82.42
6....	2	7.15	8.22	8.28	9.69	2,417	2,398	2,051	48.2	17,297	19,869	396	9.14	13.77	3.73	.93	81.57
7....	0	8.50	9.60	9.91	11 30	1 007	975	855	20.1	8,552	9,670	193	4.53	9.26	6 48	1.52	82.74
8....	-	8.33	9.38	9.68	10.66	1.616	1.566	1.422	32.2	13.458	15,158	302	7.11	8.87	6.94	1.59	82 60
9....	2	7.96	9.12	9.42	10.63	2,250	2,179	1,931	44.8	17,911	20,518	411	9.64	9.20	6.40	1.70	82.70
10....	0	8.45	9.64	9.84	10,76	1,037	1,016	929	20.7	8,769	9,998	199	4.69	8.89	.....	....	.....
11....	0	8.80	10.05	10.16	11.77	930	919	794	18.5	8,179	9,339	186	4.38	8	.....	....	.....
12....	1	8 38	9.55	9.70	11.69	1,398	1,376	1,142	27.8	11,712	13.343	266	6.26	7.15	.....	....	.....
13....	2	8.06	9.38	9.48	10.79	2 674	2,647	2,324	53.4	21,549	25,080	500	11.77	8.64	.....	....	.....
14....	1	7.75	8.94	9 00	10.10	2.338	2,321	2,068	46.6	18,127	20,892	417	9.81	8.10	.....	....	.....
15....	0	8.82	10.04	10.11	11.59	1,148	1,139	994	22.9	10,127	11.520	229	5.40	7.90	11.4	.90	79 80
16....	2	7.33	8.47	8.53	9.52	3,153	3,130	2,809	62.9	23,106	26,710	533	12.54	8,90	9	1.10	81
17....	3	7.17	8 33	8.39	9.53	3,621	3,594	3 163	72.2	25,952	30,150	602	14.15	9.70	9.1	.60	80.60

Number of trial.	Approximate fire-room air-pressure.	Heat balance or distribution of the heating value of the combustible.												Efficiency.	
		Pounds of dry gas per pound of carbon $[11(56)+8(57)+7(58)+7(59)] \div [3(56)+3(58)]$.	Heat absorbed by the boiler (B. T. U.'s), (44) × 965.7.	Loss due to moisture in coal (B. T. U.'s).	Loss due to the moisture formed by the burning of hydrogen (B. T. U.'s).	Loss due to heat carried away in the dry chimney gases (B. T. U.'s).	Loss due to the incomplete combustion of carbon (B. T. U.'s).	Loss due to unconsumed hydrogen, etc., to heating moisture in air, to radiation, etc. (B. T. U.'s).	Heat value of one pound of combustible calculated from ultimate chemical analysis (B. T. U.'s).	Heat absorbed by boiler (per cent.).	Loss due to moisture in coal (per cent.).	Loss due to moisture formed by the burning of hydrogen (per cent.).	Loss due to heat carried away in the dry chimney gases (per cent.).	Loss due to incomplete combustion of carbon (per cent.).	Other losses due to radiation, etc. (per cent. by difference).	Of boiler (per cent), (61) ÷ (67) × 100.	Of boiler and furnace (per cent), 965.7 (43) ÷ B. T. U.'s per pound of dry coal × 100.
1	8	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
1....	0	21.5	9,400	7	486	2,320	1 325	1,853	15,391	61	0.1	3.2	15.1	8.6	12	61	60
2....	1	21.7	9,520	7	505	2.970	1.571	818	15,391	61.8	.1	3.3	19.3	10.2	5.3	61.8	60.8
3....	2	18.7	9.190	8	566	3,930	682	1,015	15,391	59.7	.1	3.7	25.5	4.4	6.6	59.7	58.2
4....	0	18.8	10,870	11	492	2,290	1,388	73	15 124	71.8	.1	3.3	15.1	9.2	.5	71.8	68.3
5....	1	19.8	11,020	12	487	2.400	1.569	—364	15,124	72.8	.1	3.2	15.9	10.4	—2.4	72.8	65.6
6....	2	17.2	9,360	14	564	3.570	567	1,049	15,124	62	.1	3.7	23.6	3.7	6.9	61.9	55
7....	0	23	10,910	43	555	2 050	1.265	861	15,684	69.5	.3	3.5	13.1	8.1	5.5	69.6	64.4
8....	1	23.6	10,290	44	584	2,650	1.362	754	15,684	65.6	.3	3.7	16.9	8.7	4.8	65.6	63
9....	2	23.7	10,260	46	600	2,800	1,398	580	15,684	65.5	.3	3.8	17.8	8.9	3.7	65.4	61.3
10....	0	....	10,390	27	501	.....	.....	.....	15,475	67.1	...	3.2	....	....	.....	67.1	63.3
11....	0	....	11,360	16	496	.....	.....	.....	15,475	73.4	...	3.2	....	....	.....	73.4	65.4
12....	1	....	11,290	24	516	....	.....	.....	15,475	72.9	...	3.3	....	....	.....	73	62.4
13....	2	....	10.410	15	551	.....	.....	.....	15.475	67.2	...	3.6	....	....	.....	67.2	61
14....	1	....	9.750	11	565	.....	.....	.....	15.475	63	...	3.7	....	....	.....	63	57.9
15....	0	28.1	11,190	11	521	2,740	908	105	15.475	72.2	.1	3.4	17.7	5.9	.7	72.3	65
16....	2	24.8	9,190	11	577	3,880	989	828	15,475	59.4	.1	3.7	25.1	6.4	5 3	59.4	54.9
17....	3	23.8	9,200	12	600	4,380	519	764	15.475	59.4	.1	3.9	28.3	3.4	4.9	59.4	54

MARINE WATER-TUBE BOILER, BURNING COAL.

LIQUID FUEL FOR NAVAL PURPOSES.

In this part of his report Admiral Melville states that it is now plain why success in oil burning has but recently been attained, as it is realized that oil should be atomized before ignition and that the length of the furnace, volume of the combustion chamber, and calorimeter area are factors which must be considered. In fact, it is highly probable that it may be found advisable to design a special boiler for burning oil. In view of the trifling amount of reliable data extant concerning liquid fuel, the Navy Department has projected an extended series of tests to determine the value of liquid fuel for naval purposes. These tests were started several months ago, and were conducted upon a Hohenstein boiler installed in the Washington Navy Yard, and a comparison of the results obtained with coal and oil will prove very valuable to the maritime and mercantile world.



HOHENSTEIN MARINE BOILER, ERECTED IN THE WASHINGTON NAVY YARD, WHICH WAS SUBJECTED TO EXTENSIVE TESTS.

The problem for using liquid fuel for naval purposes is quite distinct from the problem of its use in the mercantile marine, and in considering the subject the admiral has made the following divisions:

First: The engineering or mechanical feature which relates to the efficient and economical burning of oil and to the possibilities of increasing the consumption at short notice. There are many burners in the market which atomize oil quite satisfactorily. The necessity for heating the air requisite for combustion should be recognized by all who contemplate the use of liquid fuel as a combustible. Until recent years it has been impossible to get a full horse power out of a boiler when oil is used, but now that the proper method of burning oil by first atomizing it is understood, boilers may not only develop rated horse power, but may be forced so that they develop more than could possibly be done with forced draft and coal.

Second: The commercial feature relating to the question of cost and supply is not so favorable for the use of oil in battleships as in merchant vessels, because of the limited source of supply and storage of oil fuel.

Third: The structural problem relating to the installation of oil fuel on board ship is the most difficult one of the three for the navy. As the petroleum vapors are heavy, and as most of the bulk of the oil in a warship will be carried in the double bottom, it will be difficult to free the compartments of explosive gases; and by reason of the great number of electrical appliances in use on board, thousands of sparks are likely to be caused, any one of which might result in an explosion and set the oil on fire. The Bureau has no hesitation, however, in recommending that an installation should

be effected without delay on at least a third of the torpedo boats and destroyers.

REPORT OF LIEUTENANT WARD WINCHELL ON THE VOYAGE OF THE MARIPOSA.

The steamship *Mariposa,* belonging to the Ocean Steamship Company, was, during the early months of the year, equipped with new engines and boilers, and as she was about to be completed the owners decided to install oil burners on the boilers. The vessel is of the dimensions given in the following table and was built at the Cramp yard in 1883.

Lieutenant Winchell was detailed by the Bureau to make a trip on the *Mariposa* from San Francisco to Tahiti. Only two double-end boilers were used on the trip out and back. The oil tanks are constructed out of old coal bunker space forward of the boilers, and have a total capacity of 6,338 barrels, or 905.4 tons. To fill the tanks a horizontal duplex pump 6 by 8 1-2 by 10 inches was placed in the forward fire room. There are two service or settling tanks placed in pockets formed on either side of the single-end boiler. Each tank holds about twelve hours' supply. They are filled by the oil-tank pump and have overflow back to the main pumps. There are two oil-service pumps with duplex cylinders 6 inches and 4 inches by 6 inches stroke, each one being large enough to supply all the burners. These are both placed in the forward fire room and draw their supply from the settling tanks through removable strainers, and discharge into the bottom of a small heating tank, where the oil is heated by a steam coil to not more than 150 degrees, and thence by a pipe is taken to the burners. The double-acting duplex air pump, with steam cylinders 12 inches, air cylinders 22 inches, and a common stroke of 18 inches, is placed in a pocket on the upper engine-room platform, and the air discharges into the top of the heater tank on its way to the burners, so that the oil and air go to the burners under the same pressure, which is limited to 40 pounds. The burner is of the Grundell and Tucker type and consists of a hollow plunger for the oil, screwed into a pipe through which the air passes. The outlet for the oil is through a series of small holes at right angles to the central hole. The air meets the oil through spiral directors and is sprayed into a rose shape by the expanded end of the atomizer. The air and oil pipes have globe valves for regulating the supply of either, also plug cocks for shutting off the burner immediately. The air-supply pipe is also connected to a steam line, so that steam may be substituted for air if desired. The length of the oil plunger is adjustable to give the best form to the flame. Two burners were fitted on each boiler. The air is heated on the way to the burners by passing through a hollow iron casting in the front of each furnace. In the lower part of the furnace front is a door on hinges for regulating the supply of free air.

In the double-end boilers there is a common combustion chamber for opposite furnaces. A brick bridge wall is built across these furnaces, reaching above the top line of the furnaces.

At Tahiti a careful inspection failed to show any bad effects of the flame upon the boilers. No leaks or defects developed, and the total amount of refuse swept by tube scrapers and out of the back connections and uptakes barely filled two ash buckets. This refuse, which was mainly soot, was a result not only of the twelve days' run to Tahiti but also of three preliminary trials.

No precautions other than those usually taken on board ship were made to guard against fire or explosion. All spaces to which oil has access are well ventilated by both inlet and outlet ducts. As a coal burner the *Mariposa* formerly had the following engineering force: one chief engineer, three assistant engineers, three oilers, twelve firemen, twelve coal passers, three water tenders, one messenger, one storekeeper; total, thirty-six. The fire-room force with oil burning was reduced sixteen men; and of the six firemen carried, three were relieved from watch the second day out, leaving but one man on a watch to fire twelve furnaces in two different fire rooms. The water tender did not touch the burners, except in emergency, his duty being to tend water, fill settling tanks and record the height of oil in them, record temperatures of oil at settling tank and of heater in fire room and of superheated air, take readings of the lower pyrometer where the two uptakes meet, and run oil pumps supplying oil to the settling tanks, and small oil pump supplying oil to the oil heater.

	Voyage No. 1.		Voyage No. 2.		Average
	Total.	Average.	Total.	Average.	
Knots, total	3,438		3 660		3,549.
Knots per hour		13.12		14.05	13.58
R. P. M.		65.2		70.90	68.05
I. H. P. main engines		2,193		2,770	2,481
Oil per day (bbl.)	2,803	254.8	3,277	302	278.4
Oil per day (long ton)	400.43	36.40	468.14	43.18	34.29
Oil per hour (lbs.)		3,412		4 026	3,719.
I. H. P. ÷ G. S.		8.59		10.73	9.66
H. S. ÷ I. H. P.		3.79		3	3.39
Pounds of oil I. H. P.		1.56		1.45	1.50
Pounds oil per knot.		260.9		286.3	273.6
Knots per ton oil		8.59		7.82	8.20
Knots per bbl. oil		1.22		1.11	1.16
Slip of screw in per cent		13.44		12.08	12.97
Actual time (hrs.)	263		260 1-2		

TRIAL DATA OF THE MARIPOSA.

The principal difficulties encountered were the regulation of the supply of oil to the heaters by the pump

Number of trial.	Date of trial, 1902.	Duration of trial (hours).	Kind of fuel.	Oil burner used.	State of weather.	Height of barometer at noon.	Average pressures.		Revolutions of fan blower per minute.	Average temperature (Deg. F.).		
							Steam pressure by gage; corrected for water level (pounds per square inch).	Pressure of medium used for spraying oil (pounds per square inch).		External air.	Air in fire-room.	Medium used in spraying oil.
1	2	3	4	5	6	7	8	9	15	16	17	18
1....	June 11	6	Beaumont oil.	O. C. B. W. (air).....	Bright sunny day.	30.02	273.5	3.20	327	85.4	121	(?)
2....	June 12	4	"	"	" "	30	273.5	4.62	423	86	121.5	(?)
3....	June 26	8	"	"	" "	29.70	273.5	.78	0	79	106	102.5
4....	June 27	3	"	"	Bright sun, few clouds....	29 94	273.5	3.37	483	81	108	122
5....	Aug. 2	5	"	"	Bright sunny day.....	30.13	273.5	1.41	0	87	112	120
6....	Aug. 4-9	116	"	"	(See log)....	29 89	271.5	1.31	0	79	112	113.5
7....	Aug. 15	6	"	"	Thin fleecy clouds	30.10	272.5	4.66	0	77.6	120	161
8....	Aug. 20	3	"	"	Smoky, occasional clouds.	30.08	276	4.68	506	82	115	136
9....	Sept. 12	6	"	Hayes (steam).....	Partly cloudy.	30.16	273.5	32	0	75	98	(?)
10....	Sept. 19	8	"	O. C. B. W. (steam).....	Thin clouds.....	30.20	273.1	29.9	0	69	98	444.4
11....	Sept. 20	8	"	"	"	30.18	273.7	61.4	0	77	106	408.2
12....	Sept. 22	8	"	"	Partly cloudy.....	30.05	274.2	91	0	77	103	401
13....	Sept. 27	8	"	Reed (air and steam)....	Fair.....	29.92	276.7	92	0	80.4	99.4	375
14....	Sept. 29	8	"	" "	Clear	29.96	277.4	89	0	85.4	111.5	416

Number of trial.	Approximate fire-room air-pressure (inches of water).	Average temperature (Deg. F.).			Oil.		Steam.	Water.				Economic Results.				
		Chimney gases.	Feed water entering boiler.	Steam at gage pressure (8), from steam tables.	Weight of oil used during test (pounds).	Weight of steam consumed directly or indirectly in spraying oil, in the latter case assuming 3½ evaporation units per hour per indicated horse power.	Quality of steam.	Total weight of water fed to boiler, pounds (corrected for inequality of water level and steam pressure at beginning and end of test).	Equivalent weight of water evaporated into dry steam (pounds), (26)×(24).	Factor of evaporation, $(H-h)\div 965.7$.	Equivalent weight of water evaporated into dry steam from and at 212° F. (pounds), (27)×(28).	Feed water per pound of oil (pounds), (26)÷(22).	Equivalent evaporation from and at 212° F. per pound of oil (pounds), (29)÷(22).	Pounds of steam used in spraying oil per pound of oil, (23)÷(22).	Steam used in spraying oil (per cent. of total steam generated), (23)÷(26)×100.	Cubic feet of free air used in spraying oil per pound of oil sprayed.
1	10	19	20	21	22	23	24	26	27	28	29	30	31	32	33	34
1....	1.3	704.6	120.7	413.7	10,584	2,820	0.983	117.976	115,960	1.159	134,400	11.15	12.70	0.303	2.39	34.3
2....	2.3	779	103.2	413.7	9 180	3.770	.980	96,928	94 980	1.177	111.800	10.56	12.18	.474	3.89	37.4
3....	0	503.6	128.5	413.7	6,122	827	.984	78,000	76,740	1.151	88,330	12.74	14.43	.153	1.06	62.8
4....	3.3	854	119	413.7	8,602	2,550	.981	88.604	86,915	1.161	100,900	10.30	11.73	.337	2.88	36.7
5....	0	557	129	413.7	4.668	1,153	.986	58,529	57.700	1.151	66.380	12,54	14.22	.280	1.97	70
6....	0	585	119.4	413.1	96 517	18,240	.985	1,192.482	1,174,500	1.160	1,363.000	12.36	14.12	.216	1.53	55.4
7....	0	747	119.7	413.4	9,089	7,800	.995	104 631	104,100	1.160	120,780	11.52	13.29	.990	7.45	78.3
8....	3.75	1,017	119	414.5	9.909	3,950	.988	92.997	91,870	1.161	106 690	9.39	10.77	.458	4.25	36
9....	0	449	127	413.7	3.600	2 524	.991	43,761	43.367	1.153	50.000	12.16	13.89	.701	5.77	0
10....	0	596	118.3	413.6	7.360	3.412	.995	85,791	85.350	1.162	99.170	11.65	13.47	.464	3.98	0
11....	0	628	120.2	413.8	8,257	4.252	.994	96 469	95.880	1.160	111,190	11.68	13.45	.515	4.41	0
12....	0	661	119.6	414.0	8 974	5,305	.995	105.547	105,020	1.160	121,840	11.77	13.58	.591	5.03	0
13....	0	578	121.9	414.8	7.692	8 166	.996	95.605	95,310	1.158	110,370	12.43	14.35	1.062	8.54	81.4
14....	0	645	120.8	415.0	9,216	6,838	.998	112,115	111,890	1.159	129,570	12.17	14.06	.742	6.09	78

SUMMARY OF FOURTEEN TESTS OF THE HOHENSTEIN

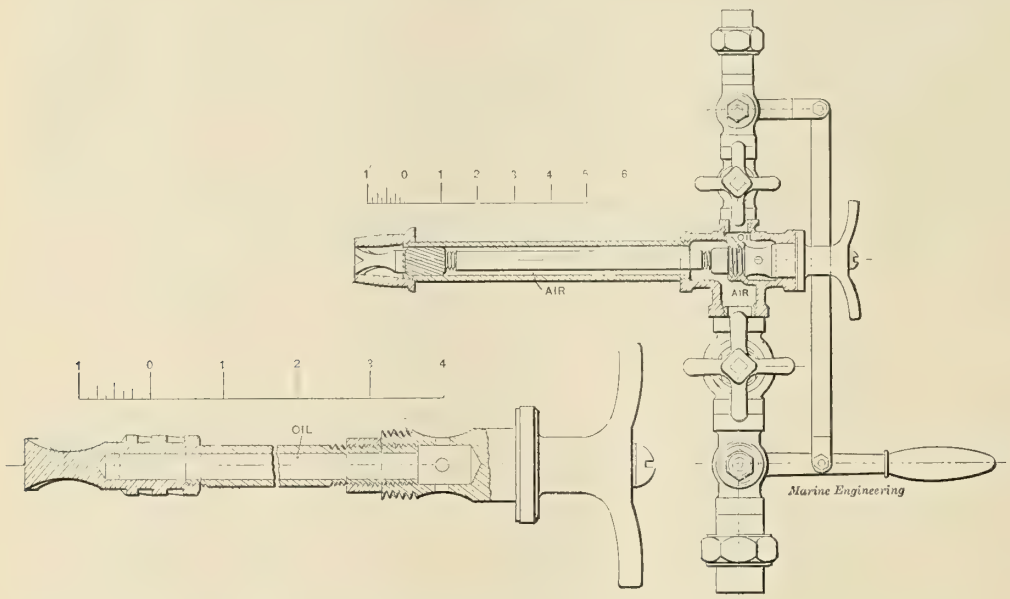
Number of trial.	Approximate fire-room air pressure (inches of water).	Fuel per hour.				Water per hour.				Chimney gas analysis.						
		Oil per hour (pounds), (22) ÷ (3).	Oil per hour per horizontal square foot of furnace (pounds), (35) ÷ 50.14.	Oil per hour per square foot of heating surface (pounds), (35) ÷ 21 30.	Steam consumed in spraying oil (pounds per hour), (23) ÷ (3).	Feed water per hour (pounds), (26) ÷ (3).	Water per hour corrected for quality of steam (pounds), (27) ÷ (3).	Equivalent evaporation from and at 212° F. per hour (pounds), (29) ÷ (3).	Equivalent evaporation from and at 212° F. per hour per square foot of heating surface (pounds), (41) ÷ 21 30.	Carbonic acid, CO_2 (per cent.).	Oxygen, O (per cent.).	Carbonic oxide, CO (per cent.).	Nitrogen, N (per cent. by difference).	Pounds of dry chimney gas per pound of carbon, $[11(44) + 8(45) + 7(46) + 7(47)] \div [3(44) + 3(46)]$.	Percentage of carbon in oil by chemical analysis.	Pounds of dry chimney gas per pound of oil, (48) × (49).
1	10	35	36	37	38	39	40	41	43	44	45	46	47	48	49	50
1....	1.3	1,764	35.15	0.83	535	19,663	19,327	22,400	10.5	6.97	8.77	1.50	82.76	28.99	83.26	24.1
2....	2.3	2,295	45.8	1.08	1,088	24,232	23,475	27,975	13.1	6.96	9.20	1.20	82.64	30.11	83.26	25.1
3....	0	765	15.25	.36	117.5	9,750	9,593	11,041	5.18	7.24	10.2	.425	82.135	32.15	83.26	26.8
4....	3.3	2 867	57.2	1.35	967	29,535	28,972	33,633	15.8	7.50	10.4	.3	81.80	31.64	83.26	26.4
5....	0	933.6	18.6	.44	262	11,706	11,540	13,276	6.23	7.70	10	.13	82.17	31.54	83.26	26.3
6....	0	832	16.6	.39	179.5	10,280	10,125	11,750	5.52	7.68	10.25	.06	82.01	31.91	83.26	26.6
7....	0	1,515	30.2	.71	1,501	17 447	17 360	20 137	9.45	10.1	6.64	.275	82.985	24	83.26	20
8....	3.75	3,303	65.9	1.55	1,511	31,001	30 629	35,560	16.7	7.87	9.66	.22	82.25	30.54	83.26	25.4
9....	0	600	11.97	.28	421	7,294	7.228	8,333	3.91	5.5	13.05	.27	81.18	42.47	83.26	35.4
10....	0	920	18.34	.43	427	10,724	10 669	12,396	5.82	6.99	11.05	.013	81.95	35.16	83.26	29.3
11....	0	1,032	20.57	.48	532	12,057	11,985	13,899	6.52	7.47	10.66	.086	81.78	32.64	83.26	27.2
12....	0	1,122	22.35	.53	663	13 193	13 128	15,230	7.15	8.44	9.29	.014	82.26	29.29	83.26	24.4
13....	0	962	19.15	.45	1,021	11,951	11 914	13.796	6.48	7.70	9.85	.075	82.37	31.70	83.26	26.4
14....	0	1 152	22.95	.54	855	14 014	13,986	16,196	7.60	8.53	9.04	.05	82.38	28.85	83.26	24

Number of trial.	Approximate fire-room air pressure (inches of water).	Heat balance, or distribution of the heating value of the oil.													Efficiency.	
		In British thermal units.							In percentages of the total heating value of the oil.							
		Heat absorbed by the boiler. (31) × 965.7.	Loss due to superheating steam used in spraying oil.	Loss due to moisture formed by the burning of hydrogen.	Loss due to heat carried away in dry chimney gases.	Loss due to incomplete combustion of carbon.	Other losses—due to unconsumed hydrogen, to heating moisture in air, to radiation, etc., by difference.	Heat value of one pound of oil, calculated from chemical analysis.	Heat absorbed by boiler.	Loss due to superheating steam used in spraying oil.	Loss due to moisture formed by the burning of hydrogen.	Loss due to heat carried away in dry chimney gases.	Loss due to incomplete combustion of carbon.	Other losses—due to unconsumed hydrogen, to heating moisture in air, to radiation, etc.	Of boiler (per cent.), [(51) ÷ (57)] × 100 = (58).	Of boiler and furnace (per cent.), $(64) \times \left[1 - \frac{(33)}{100}\right]$.
1	10	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65
1....	1.3	12 250	0	1,440	3.375	1,495	921	19.481	62.8	0	7.4	17.3	7.7	4.8	62.8	61.3
2....	2.3	11,760	0	1.480	3,925	1,242	1,074	19.481	60.3	0	7.6	20.1	6.4	5.6	60.3	58
3....	0	13.930	0	1,350	2.565	469	1,167	19.481	71.5	0	6.9	13.2	2.4	6	71.5	70.7
4....	3.3	11,320	0	1,540	4.720	326	1,575	19 481	58.1	0	7.9	24.2	1.7	8.1	58.1	56.4
5....	0	13,720	0	1.370	2,800	141	1,450	19 481	70.4	0	7	14.4	.7	7.5	70.4	69
6....	0	13,620	0	1,390	3,020	66	1 385	19.481	69.9	0	7.1	15.5	.3	7.2	69.9	68.8
7....	0	12,830	0	1.470	2.945	224	2 012	19.481	65.8	0	7.5	15.1	1.2	10.4	65.8	60.9
8....	3.75	10,400	0	1.620	5,480	230	1,751	19.481	53.4	0	8.3	28.1	1.2	9	53.4	51.1
9....	0	13,413	58	1,366	2,990	395	1.259	19,481	68.9	.3	6.9	15.4	2	6.5	68.9	64.9
10....	0	13.008	77	1 445	3,500	16	1,435	19.481	66.7	.4	7.4	18	.1	7.4	66.7	64.1
11....	0	12.989	79	1,458	3,410	97	1.448	19,481	66.7	.4	7.5	17.5	.5	7.4	66.7	63.8
12....	0	13,114	93	1,479	3.270	14	1,511	19.481	67.3	.5	7.6	16.8	.1	7.7	67.3	63.9
13....	0	13,857	125	1,431	3.000	82	986	19 481	71.1	.6	7.4	15.4	.4	5.1	71.1	65
14....	0	13.578	112	1,465	3,070	49	1,207	19 481	69.7	.6	7.5	15.7	.3	6.2	69.7	65.4

MARINE WATER-TUBE BOILER, BURNING OIL.

and the consequent variation of the temperature of the heated oil and the freedom of flow through the burners. If the oil is heated above 150 degrees some of the gases are driven off and mingle with the air pressing on top of the oil in the heater, thence passing with the air into the air superheater, the result being that on one occasion a heater became red hot from this cause. The air in the superheater is raised to 350 degrees. Another difficulty was due to the choking of the strainers by foreign matter and impurities in the oil. While making necessary repairs to the compressor steam was used for atomizing for two and one-half hours, when the number of turns to the main engine were but slightly reduced.

Full power was not developed in the two boilers used, as schedule time was easily exceeded with from two to four burners shut off. In the preceding table the calculations are based on the horse power of the main engines only. Cards were taken from the main engines twice a day, and the horse power for the day was calculated by comparing that of the cards with that which would be indicated at the average number of turns for the day.



THE GRUNDELL-TUCKER BURNER USED ON THE MARIPOSA.

REPORT OF BOARD ON TESTS OF LIQUID FUEL FOR NAVAL PURPOSES.

A preliminary report made by the board appointed to conduct an experimental series of tests for determining the value of liquid fuel for naval purposes, is included in the annual report of the Chief of the Bureau of Steam Engineering. After stating the advisability of the navy's conducting the tests, the board proposes the following problems:

1. The relative advantages of air and steam as an atomizing agent for liquid fuel, and, where steam is used, the amount of superheat that should be applied.

2. The pressure at which oil, steam, and air should be delivered to the burners.

3. The design of steam generator.

4. The simplest and most economical means of heating the air and oil, as the board believes there is no doubt but the air should be heated.

5. The value or necessity of a receiver when compressed air is used.

6. The necessity of baffling plates for the gases.

7. The relative value of the leading types of burners.

8. Whether oil can be consumed under all conditions without producing smoke, which is of special importance to the navy.

The plant used for testing was that on which the coal-evaporative tests of the Hohenstein boiler were conducted, with necessary connections of steam, oil, and air for operating the burners. The feed water and fuel oil were weighed in receiving tanks; the air for atomizing was supplied by a Root blower, and the oil used was from the Beaumont field and had probably been subjected to an inexpensive treatment which removed the sulphur and some of the more volatile hydrocarbons. The board believes, from knowledge at hand, that this oil is preferable to crude oil. The calorific value of the oil was given at 19,481 British thermal units.

The temperatures at the base of the stack were remarkably free from the rapid fluctuations which characterized coal-burning trials.

In making the tests of the different burners, the following points were ascertained: The evaporative efficiency of oil was compared with coal under like conditions; the degree to which the combustion of oil could be forced with both steam and air, with natural and forced draft; the ability of a burner to work under forced-draft conditions; the liability of injury to the boiler; the amount of steam or air requisite for atomizing; the amount of pressure which should be applied; the effect of heating the entering air; the time required to train men to operate the burners; means for reducing the noise of the burners, and the attitude of the firemen as regards operating oil installation.

During an endurance test of 116 hours the employees of the Oil City Boiler Works conducted the tests during the daytime, and the crews of the torpedo boats *Gwin* and *Rodgers* were on duty during the night watches. After some preliminary training the navy employees were able to run the boiler as successfully as the experts in the day watch.

states that in its opinion the interests of the navy and private parties will best be served by having tests conducted by persons within the navy. The report is signed by Lieutenant-Commanders John R. Edwards, Wythe N. Parks, and Frank H. Bailey. On pages 644, 645 will be found a summary of the fourteen different tests made by the board.

HOHENSTEIN WATER TUBE BOILER.

Drums at water-surface level:
- One front drum,.....24 in. inside dia.
- One rear drum.....24 in. dia.
- Four connecting drums.....16 " "
- One lower rear mud drum.....24 " "

Tube-heating surface:
- Three hundred and eighty-four 2-in. tubes.....9 ft. long.
- Sixteen 4-in. tubes.....7 " "
- Fifteen down-take tubes.....5 in. dia.

Floor space occupied,
9 ft. wide, 10 ft. 11¼ in. deep.
- Height above floor line.....12 ft. ¾ in.
- Height over all.....12 " 6¾ "

Heating surface:
- 2,174 sq. ft. for tests No. 1 to No. 6, inclusive.
- 2,130 " " " " 7 " " 17 "

Per cent. water-heating surface.....100

Grate surface:
50.14 sq. ft., 6 ft. 4 in. long, 7 ft. 11 in. wide.

H. S. ÷ G. S.:
- 43.4 to 1 for tests No. 1 to No. 6, inclusive.
- 42.5 to 1 " " " 7 " " 17 "

Volume of water at steaming level...142 cu. ft.
Volume of steam space..... 50 " "
Area of steam liberating surface.....75 sq. ft.

Weight of water at steaming level and 275 pounds pressure .....7,559 lbs.
Weight of boiler and fittings, excluding uptake and smoke pipe:
- Without water.....46,568 lbs.
- With water.....54,127 "
- Without water, per sq. ft. of H. S.:
  - 21.4 lbs. for tests No. 1 to No. 6, inclusive.
  - 21.8 " " " " 7 " " 17 "
- With water, per sq. ft. of G. S.....1,080 lbs.

Height of furnace.....2 ft. 5 in.
Volume of furnace above bars.....121.14 cu. ft.
Width of air spaces between grate bars:
- Five-eighths inch for tests No. 1 to No. 11, inclusive.
- Three-fourths inch for tests No. 12 to No. 17, inclusive.

Ratio of grate area to area of air space:
- 1⅛ : ⅝ = 1 : 0.555 for tests No. 1 to No. 11, inclusive.
- 1¼ : ¾ = 1 : 0.60 for tests No. 12 to No. 17, inclusive.

Height of smoke pipe above grate.....70 ft.
Area of smoke pipe.....8.73 sq. ft.
Ratio of smoke-pipe area to grate area.....1 : 5.75.
Number of fire doors.....3

NAME—Mariposa. NATIONALITY—American. BUILDER—Wm. Cramp and Sons.

LAUNCHED—1883. OWNER—Ocean Steamship Co. TYPE—Ocean Steamer.

RE-ENGINED—Risdon Iron Works, 1902.

Length between perps.....314 ft.
Beam, molded ..... 41 "
Depth, " .....17 ft. 3 in.
Load draft.....22 ft.
Propeller.....4 blades
- Diameter .....16 ft. 6 in.
- Pitch.....23 ft.

Engine.....triple expansion
- Diameter cylinders.....29, 47, 78 in.
- Stroke .....51 in.

Boilers.....two double end; one single end
- Type .....Scotch
- Length.....17 ft. 3 in.; 19 ft. 9 in.
- Diameter.....15 " 3 " 14 "
- Number of furnaces..... 6 3
- " " comb. chambers..... 3 1
- G. S. (two double-end)..... 516 sq. ft.
- H. S. (two double-end).....16,604 " "

In making tests of the various burners it was found necessary to allow the different makers to conduct preliminary trials, as the problem of fitting burners to a boiler capable of developing 2,000 horse power was a different matter from installing the burner on a small boiler.

The board recommends the immediate installation of oil-fuel appliances on two torpedo boats and two destroyers for testing the adaptability of oil with water-tube boilers of the bent-tube type, and in conclusion it

Saving a Derelict.—The Yankee schooner *R. B. Woodside,* which was abandoned in a sinking condition on February 26, 1901, as the official report states, was recently towed into Abaco, New Providence, after having drifted 8,000 miles about the Atlantic. The crew had been taken off the schooner, which was bound from Jacksonville to New York, by a passing steamer, and since then the derelict has been frequently sighted in various places on the ocean, and has been a great source of danger. She was recently sighted 400 miles from the Bahamas and towed into the above-named port.

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THE subjects of the papers read at the annual meeting of an engineering society should be a reflex of the questions and problems which are chiefly to the fore in such fields of engineering work. If such is the case, the chief questions of importance in the field of marine construction are the design, construction, and armament of naval vessels, the balancing of engines, vibrations of steamships, steamship trials, courses of education for naval architects, the geometrical theory of naval architecture, the applications of electricity on shipboard, the strength of ships, water-tube boilers, and rules for yacht measurement.

Such, in any event, is the character of the programme of the papers for the annual meeting of the Society of Naval Architects and Marine Engineers held on the 20th and 21st of last month. Whether or not all of these questions are of the importance which their place on the programme might seem to indicate is a question of opinion or judgment; but, in any event, the programme as a whole must be taken as a general indication of the topics considered most important by those members having the inclination to present papers for the consideration of the society. As usual, we present this month as a special feature a careful synopsis of the papers read at this meeting, together with the more important points brought out by the discussion. This will enable our readers to form an excellent idea regarding the general character of the meeting, the papers presented, and the discussion provoked. Looking at the matter from an impartial viewpoint, it may fairly be said that the discussion of the papers leaves, as a rule, something to be desired, and, secondly, that there is a lack of papers of definite and permanent technical value to the profession at large. The character of the discussion seems to result from the fact that the average American engineer is too busily occupied to take the time for a careful study of the papers before the meeting and for the preparation of an illuminating discussion. It is always the case, furthermore, that some of the papers are in hand too short a time before the meeting to permit of the study necessary for such a discussion. The secretary cannot perform the impossible, and so long as human nature remains what it is, so long will papers come in at the eleventh hour, thus preventing the preparation of any adequate discussion. Even if the papers were distributed to the members a month before the meeting, we are not sure to what extent this would tend to produce more carefully prepared discussion of the points presented.

Regarding the character of the papers, they are, of course, the product of the surroundings in which their authors are occupied and of the influences which necessarily react on the character of the paper; and among such influences none is perhaps stronger than the commercial. This acts as a limitation or restriction and prevents the author from giving to his colleagues the very points regarding his own work which they are most anxious to know, and in many cases to remove from his paper all description of the ways and means whereby given results are attained, and to reduce it to a mere statement of results without reference to the steps by which they have been reached. There is, of course, room for descriptive papers or for those which simply record results. Such have their historical value and serve as a record of progress; but while it is hardly to be expected that the detailed results of large investments of time and money shall be freely given to the profession at large, it may be fairly questioned whether some larger proportion of matter of direct technical value might not be included in many such papers without any serious hazard to the commercial interests involved.

THE annual report of Rear Admiral Melville, Engineer-in-Chief of the Navy, comes to hand, freighted as usual with its vigorous discussion of all matters relating to engineering in the Naval Service, and its rich fund of information regarding the routine and experimental activities of the Bureau during the year. Chief among the latter is found a detailed account of recent tests with the Hohenstein type of water-tube boiler, carried out with both coal and liquid fuel. In the latter case the experiments constituted a most exhaustive and valuable study of the capabilities of liquid fuel, especially as applied to the water-tube type of boiler.

Regarding the general question of water-tube boilers, the report states the main points of advantage of the water-tube type for the Naval Service, and points out the desirability of continuing the "trying out" process in order to learn by actual experience the types and forms best suited to the requirements of the service. For the battleships now in course of construction, water-tube boilers of three types are contemplated—the Babcock and Wilcox, Niclausse, and Thornycroft. A new type, known as the Hohenstein, was submitted to the Bureau for test early in 1901, and since that time has served as the basis of a most extended series of tests, both as a water-tube boiler and as a steam generator for use with various systems for burning oil fuel. As a result of the trials, so far as they relate to the boiler, the type has been approved and recommended for installation on some ship building for the Naval Service. We have before referred in these columns to the wisdom underlying this policy. It is very sure that no one water-tube boiler can be the best for all conditions of service, nor is it to be assumed that any particular one should at the present time be selected as a sole standard or be considered as having reached a final stage of development. Rather, it is sure that the problem of the water-tube boiler can only be solved by a process of selection among the most promising types, such selection being made under actual working conditions at sea.

The report gives also extended reference to the subject of oil fuel, liberal extracts from which will be found on another page of the present issue. Taken as a whole, the report maintains the high standard which we have been led to expect by the similar reports of preceding years, and its careful perusal may be recommended to all who are interested in the welfare of the Naval Service.

WE have shown on another page a cut of the United States naval fleet in European waters in 1872. The advance in engineering progress from day to day, or even from year to year, seems so slow to those who are engaged in the work that it is well at times to take a more general view of the distance covered in a considerable period of years, the better to appreciate how significant and how great the sum total of the daily steps becomes when allowed to accumulate through such a length of time. The engineer is a man who naturally looks forward, ever striving for the advancement of his profession. A retrospect is, however, sometimes useful, in order that he may the better note the trend of the lines of progress and the better adjust himself to the future as derived from the past. The machinery of the United States fleet of 1872 will furnish to the thoughtful engineer abundant food for a retrospect of this character. The engines were all small, of 500 to 1,000 I.H.P., using steam pressures of 30 to 50 pounds, and with boilers to suit. The compound engine was just then appearing prominently above the horizon, and the Engineer-in-Chief had shortly before returned from an extended visit in Europe, where he had observed such examples of compound engines as came under his notice, and on his return recommended in his annual report the adoption of this type of engine for naval service.

About this same time the department had ordered the removal of all four-bladed screws from such ships as were fitted with them, and their replacement by two-bladed screws, in order to improve the handling of the ships under sail. To this action strong objections were made by the Engineer-in-Chief, but to no avail, and the steaming capacity of the ships was therefore sacrificed in order that they might stand a better chance of manœuvering under sail in squadron with sailing ships, without being distanced by the older ships adapted to propulsion by sails alone.

We have no intention of developing any extended comparison with the present, as interesting and instructive as such comparison might be made in points of detail. A realizing sense of progress is often gained by quick glances at the extremes of the period under consideration, and in this case the bare statement of facts, and the thought that these facts relate to a period just about a generation ago, are quite sufficient to show how profound has been the change and how great the progress in that period.

PRACTICAL POINTS IN SHIPBUILDING.—II.

BY EADS JOHNSON.

ANGLEWORK.

After the major part of a ship's framework has been completed, including frames, reverse frames, beams, keelsons, stringers, gunwale and waterway angles, etc., the small anglework, including clips, lugs, and staples, brings out many forms of angles, among them such as

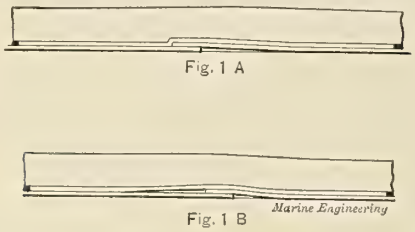


Fig. 1 A

Fig. 1 B

are shown by the accompanying sketches. The working of the straight angle into these shapes necessitates clever smithwork, in return for which an anglesmith working on the piecework system draws good pay. The most common form to which an angle is smithed is in the case of an offset over a lap or butt strap, as shown in Fig.

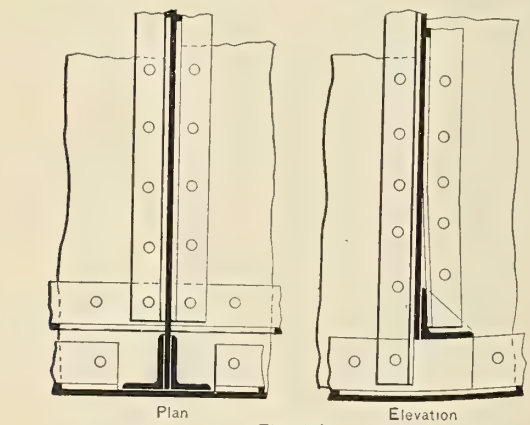


Fig. 2 A

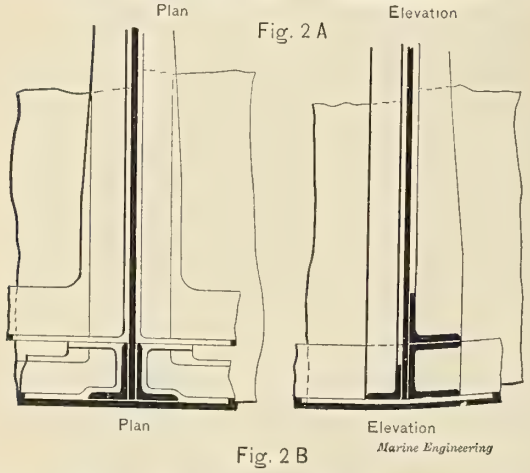


Fig. 2 B

1 *A*. Where a neat or water-tight job is required, as with a bulkhead-bounding angle, in way of a lap of the deck plates, the angle is worked in this manner. When water-tightness is not essential the angle may be run over as shown in Fig. 1 *B*, and a small tapered liner used.

Fig. 2 *A* shows an elevation of a bulkhead frame, beam, bracket, and section of stringer angle. The bulkhead being non-water-tight, the bounding angle runs into the bosom of the stringer, a tapered liner being used. Fig. 2 *B* shows where the bulkhead is water-tight, and the stringer, instead of running through the bulkhead, is turned around and makes a butt with the bounding angle; the shell clip gives way to a small staple between the stringer and shell, thus giving available calking edges.

Where the side or sister keelson angles are riveted

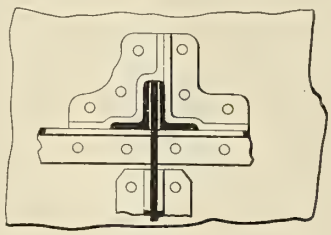


Fig. 3

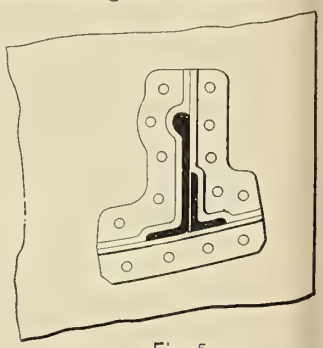


Fig. 5

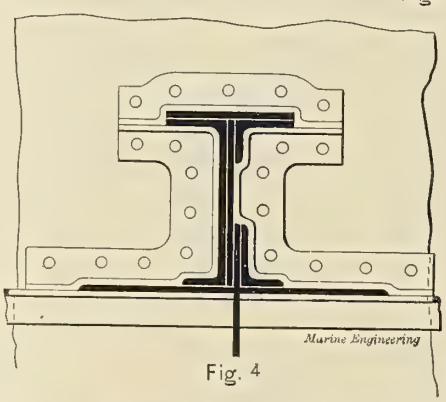


Fig. 4

back to back, as in Fig. 3, a shoe is made to fit the shape of the angles. This is placed usually on but one side of the bulkhead, a plate collar being used on the other side. Where the bulkhead is subject to pressure, as in the fore or after peak tank, a shoe staple is used on both sides.

When the center keelson runs through a water-tight bulkhead a staple such as in Fig. 4 is necessary for fitting around the keelson, angles, stringer, and rider plate. The staple may be made to fit this section perfectly, but two offsets can be done away with by using a short parallel liner on one side. The side keelson is treated in a similar manner, the angle staples being made similar to those shown in Fig. 5; but where the keelsons do not run through the bulkhead, which is sometimes the case, they are cut and bracketed to the bulkhead on fore and after sides.

A peculiar form of staple, and a difficult one to make, is required when a water-tight bulkhead strikes the protective deck of a modern cruiser or battleship. Here, as illustrated in Fig. 6, the deck runs out to the shell and the bulkhead is continued to the shape of the protective deck. Where the deck forms the top of the fore or after peak tank a staple such as shown in Fig. 7 is necessary, in order that the deck in way of the frames and shell may be properly connected and give available calking edges. In such cases the deck stringer angle may be omitted to advantage, as the staple performs the functions of the shell clip, water-tight staple, and where

the staples overlap each other a continuous chain is formed, which is also a stringer. If the stringer angle were run along the deck and riveted to the reverse frames the staple between the frames would be as shown in Fig. 8. It is evident that calking the lower flange behind the stringer would be a difficult job, and the probable method would be riveting and calking the staple before the stringer angle is put on.

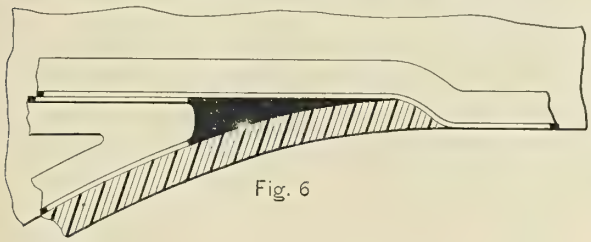


Fig. 6

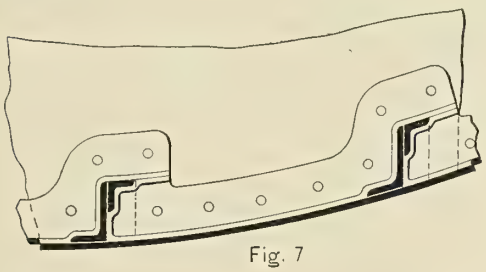


Fig. 7

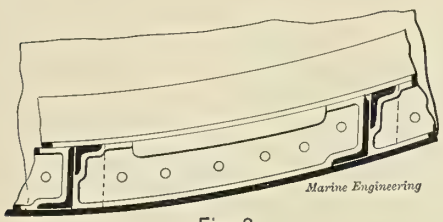


Fig. 8

Usually staples can be worked neat enough to make a good water-tight job without depending upon or resorting to any form of stopwater. In all water-tight work, however, the stopwater is more or less used, especially in jobs of poor workmanship.

COMMUNICATION.

Editor MARINE ENGINEERING:

I think the readers of MARINE ENGINEERING ought to feel very much indebted to you for calling forth and publishing the valuable letters on page 555 of the November magazine headed "Opportunities for Entering Engine-Room Service." I like the genuine ring of Mr. Carnegie's letter, and the able letter of Mr. Center, of the Pacific Mail Company, strikes the nail on the head.

How any country can ever expect to get its marine engineers from the trimmer or fireman class is beyond my comprehension. Yet this Canada of ours enforces laws that a man who has served forty-eight months as fireman is eligible for passing the examination, or, as the law reads, "is entitled to a fourth-class engineer's certificate." When he reaches that grade he is called an engineer and can mount to the highest class without one day's training in an engineering establishment, only four years handling a shovel. We have them here often going about idle, for no engineer who knows them will trust such a one to pack a bilge pump, but they often succeed in obtaining work from people who do not know them, by producing this mighty document, an

Engineer's Certificate from the Great Dominion of Canada.

I do not know the regulations relating to the examination of engineers in the United States, but from the tone of many of the letters in last month's MARINE ENGINEERING I would conclude that you, too, back up the fireman class of marine engineers with all the majesty and authority of United States law.

My advice to young men seeking employment always is: Serve your apprenticeship of five years, make yourselves competent workmen, then come to me if you want to become marine engineers, but don't disgrace your profession by wanting to start as oilers. Oilers with us are good firemen, firemen are good trimmers promoted, but neither of them could ever become engineers on account of their being oilers or firemen, any more than they could become doctors or lawyers without going through the proper training.

Halifax, Canada. OLD SALT.

QUERIES AND ANSWERS.

Q. 112.—Will you please inform me how to estimate the sizes of pump cylinders required to pump a certain number of gallons of water in a given time at varying elevations?

A.—Having given the number of gallons to be pumped in a given time, the volume per minute can be found by the following rule: Find the gallons per minute and multiply this by .1337, or, more shortly, by .134. The product will be the volume per minute in cubic feet.

To this must be added a certain amount to provide for the leakage past the plunger and past the valves. A pump plunger which displaces 1 cubic foot per stroke will not deliver that volume of water net. A certain amount will escape by leakage, and this must be provided for in estimating the plunger displacement. The amount of such leakage will depend on the condition of the pump, but should not exceed 10 per cent., though with the plunger and valves in bad mechanical condition it might rise considerably above these figures. An increase of from 10 to 20 per cent. should, however, cover this allowance in any ordinary case.

The next point to be settled is the number of strokes of the pump per minute, and whether the pump is to be single or double acting. These points settled, we then know the number of strokes per minute on which delivery of water is made. If the pump is single acting it will be the so-called number of double strokes or revolutions per minute. If the pump is double acting it will be twice this, or the number of single strokes per minute.

We then divide the total delivery per minute by the number of delivery strokes, and find the volume to be displaced by the plunger in one stroke. A suitable diameter and length of stroke can then be chosen to give this displaced volume.

The size of the cylinders thus found will be independent of the height to which the water is to be forced. The latter point will only affect possibly the slip of the pump or the percentage to be added to make up for leakage. It will affect the work done, but, aside from leakage, will not affect the necessary size of pump cylinder.

These operations may be illustrated by the following example:

Required, the size of pump cylinder for a double-acting pump making 40 double strokes per minute and to deliver 200 gallons per minute.

For the volume per minute we have $200 \times .134 = 26.8$ cubic feet. To this add 10 per cent. of itself, making $26.8 + 2.68 = 29.48$ cubic feet.

Since the pump is double acting and makes 40 double strokes per minute, there will be 80 delivery strokes per minute. The volume of one stroke will be, therefore, $29.48 \div 80 = .3685$ cubic feet $= .3685 \times 1728$ cubic inches $= 637$ cubic inches. We must now select a suitable diameter and length of stroke. This may require a few trials, but we shall soon find in this case, for example, that a cylinder 8 inches in diameter and 12 3-4-inch stroke will answer the requirement, or, if a shorter stroke is desired, it may be made 9 inches in diameter and 10 inches stroke.

If the pump is to be duplex, the size of each cylinder will be just one-half that required for a single pump for the same delivery.

Q. 113.—Please explain what is meant by the thermal H.P. or thermal pressure, as applied to a four-cylinder, triple, or other type marine engine. How is it figured? A. E. Z.

A.—The terms thermal horse power and thermal pressure must have been specially coined, as they are not in use in engineering. The thermal horse power might mean the I.H.P. divided by the thermal efficiency of the engine, or the horse power expressed in British thermal units—namely, 33,000 foot pounds divided by 778, the latter number representing the number of foot pounds equivalent to 1 B.T.U. Similarly, thermal pressure might mean the mean effective pressure divided by the efficiency.

Q. 115.—I intend using a 21-foot launch, and would like to know whether I would need to have the boilers for same inspected, and is it necessary to have a licensed engineer to run same? The engine is about 5 horse power. J. S.

A.—If the launch referred to is used for pleasure purposes only and is under 10 gross tons, it may be run by a special engineer; otherwise, a certified engineer will be required. In any case the boiler must be inspected.

Q. 116.—Will you please give one of your readers your views in regard to the following question: Is a propeller having two bronze blades and two iron blades opposite each other better balanced than a propeller having three bronze blades and one iron blade? The iron blades in each case are thicker and heavier than the bronze blades. G. E., Baltimore.

A.—The question of balance will depend entirely as to the location of the center of gravity of each blade and the weight of each blade. As the specific gravity of cast iron is about 7.1, and that of bronze about 8.3, the iron blades must be larger or heavier than the bronze ones. Assuming that the iron blade is of the same weight as the bronze, and its center of gravity is the same distance from the center of the shaft as the bronze blade, the propeller wheel will be balanced, whether one or two cast-iron blades be used.

Twenty-five-Knot Cunard Steamships.—The announcement of the Cunard Steamship Company that it will build two high-speed transatlantic steamships shows the intention of the British company to wrest the supremacy of the Atlantic from the Germans, who have held it for the past eight years. The dimensions of the vessels are stated to be about 750 feet long, 75 feet beam, with a horse power of 50,000. These figures, however, are only tentative. Although it is probable that quadruple-expansion reciprocating engines and twin screws will be adopted, this point has not been definitely settled.

Speed of Ship in Shallow Waters.—The chief of the North German Lloyd experimental station, Mr. J. Schütte, states that fast small craft like torpedo boats may run faster in shallow than in deep water, and that their trial runs in open water may be very misleading. His experiments with models demonstrate that boats whose length does not exceed 9.5 times the width, required in deep water an open channel of at least ten or twelve times their width. Regarding depth, the influence of the tank vanished for models of large steamers only when the available depth was 10.5 times the draft, and for the torpedo boats when the depth was sixteen times the draft. Thus trials of torpedo boats should be run in 160 feet of water to allow for increased draft due to sinking of the stern.

The United States Fleet in European Waters in 1872.

The advance in naval construction during the past thirty years is well indicated by a comparison of the fleet shown in the accompanying cut with a fleet of the present time.

On December 30, 1871, Rear Admiral James Alden, in his flagship, the *Wabash*, arrived at Villefranche, and on the 1st of January following relieved Rear Admiral Charles S. Boggs of the command of the United States naval forces on the European station. The vessels on the station during the next year and which formed the fleet of Admiral Alden were the *Wabash*, 45 guns; *Brooklyn*, 20 guns; *Congress*, 16 guns; *Plymouth*, 12 guns; *Shenandoah*, 11 guns; *Wachusett*, 6 guns—or, in all, 6 vessels and 110 guns.

These ships were all wooden and of the steam-frigate and sloop-of-war classes. The means of propulsion in all were by the screw propeller. The *Wabash* was a fine example of the old steam-frigate type, built in 1854 and of 4,650 tons displacement. The *Brooklyn* was built in 1857 and was somewhat smaller, having a displacement of 3,000 tons. The *Shenandoah*, 2,100 tons: *Wachusett*, 1,575 tons; and *Congress*, 3,050 tons, were built during the war, the latter in 1863 and the other two in 1861. The *Plymouth* was the newest of all, built in 1868 and of 2,400 tons displacement.

It is interesting to note that the combined displacement of these six ships is 16,775 tons, which is substantially the same as that of the new battleships *Connecticut* and *Louisiana*, now building, while of course the combined energy of gunfire would be insignificant as compared with that of a modern ship.

During the early part of the year the vessels of the fleet were kept together, with an occasional exception, and thus visited the principal ports of France, Portugal, and some of the ports of Germany, and the waters of England. Later in the year they returned to the Mediterranean, where separately they visited the various ports in southwestern Europe, the Levant, and the north and west coasts of Africa.

Admiral Alden's cruise extended from January 1, 1872, to June 2, 1873, when he was relieved and returned

Brooklyn. *Shenandoah.* *Wabash.* *Juniata.* *Wachusett.* *Plymouth.*

EUROPEAN SQUADRON, WABASH, FLAGSHIP, COMMANDED BY ADMIRAL ALDEN, 1872.

Copyright, 1902, by Enrique Muller, Brooklyn, N. Y.

home in the *Brooklyn,* where he arrived on the 10th of the following month. Throughout the cruise the usual exchange of courtesies took place between the admiral and his staff on the one hand and the officials and representatives of the ruling houses in the various European countries on the other, all of whom gave evidence of kindly feeling for the Government and people of the United States. While marked by no special incidents, the cruise of Admiral Alden has taken its place as one in which our flag was shown abroad with dignity and honor, and the old wooden ships of his fleet, now all but forgotten, well deserve a passing thought in this day of the modern steel fighting machine which has forever displaced the naval ideals of those days.

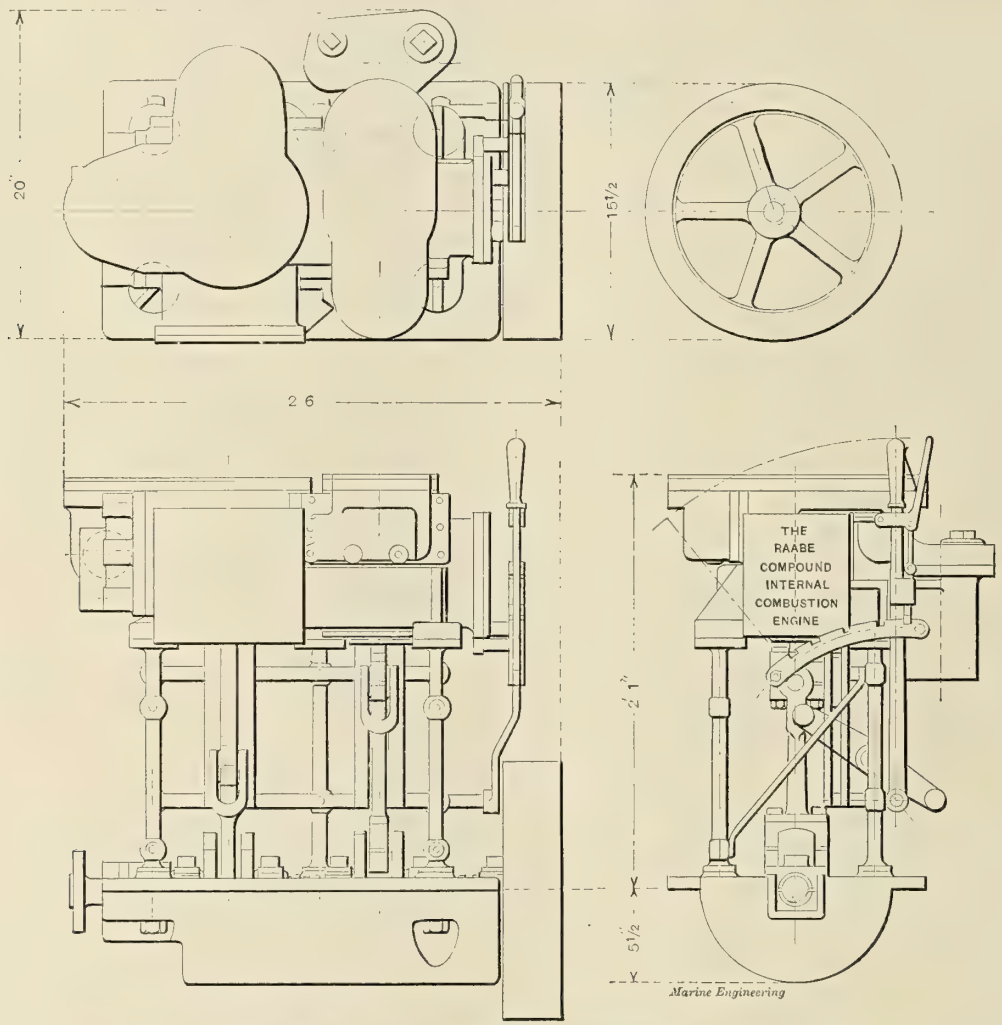
ENGINEERING SPECIALTIES.

Compound Internal-Combustion Engine.

The engines shown in the accompanying illustrations not only differ from other explosive engines, due to their great economy in floor space and weight, but also, being the first successful compound internal-combustion engines constructed, they also differ in cycle and their extremely high fuel economy.

The engraving on page 655 represents the 20-horse-power Raabe steeple compound marine-type engine, the weight of which is only 500 pounds, covering a total floor space of two square feet, with the following dimensions: Height from floor level to clearance line, 37 inches; length of bed plate, 17 1-2 inches; width of bed plate, 15 inches; length over all, including flywheel and coupling, 19 1-2 inches; width over all clearance, 18 inches; diameter of flywheel, 16 inches; weight of flywheel, 70 pounds; number of revolutions per minute, 600 to 800. In the line drawing is shown the fore-and-aft compound marine-type engine of 20 horse power, with a weight of 500 pounds, covering a total floor space of 3 square feet. The dimensions are as follows: Height from floor level, 28 inches; length of bed plate, 24 inches; width of bed plate, 15 inches; length over all, 30 inches; width over all, 21 inches; diameter of flywheel, 15 inches; weight of flywheel, 65 pounds; number of revolutions per minute, 800 to 1,000.

The fuel used in these engines is ordinary kerosene oil, but, if preferred, gasoline or common illuminating gas may be used without making any changes to the engine. The mechanical reversing gears, which are so well known to the owners of launches, are entirely abandoned, as the whole engine reverses with a positive reversing gear—*i. e.*, if the go-ahead gear is thrown into action by means of the reversing lever shown in the cuts, it will be impossible to run the engine in the opposite direction; the same holds true about the go-astern gear. By throwing the lever into the midway position the engine is stopped, and any intermediate position regulates it for slower speeds.

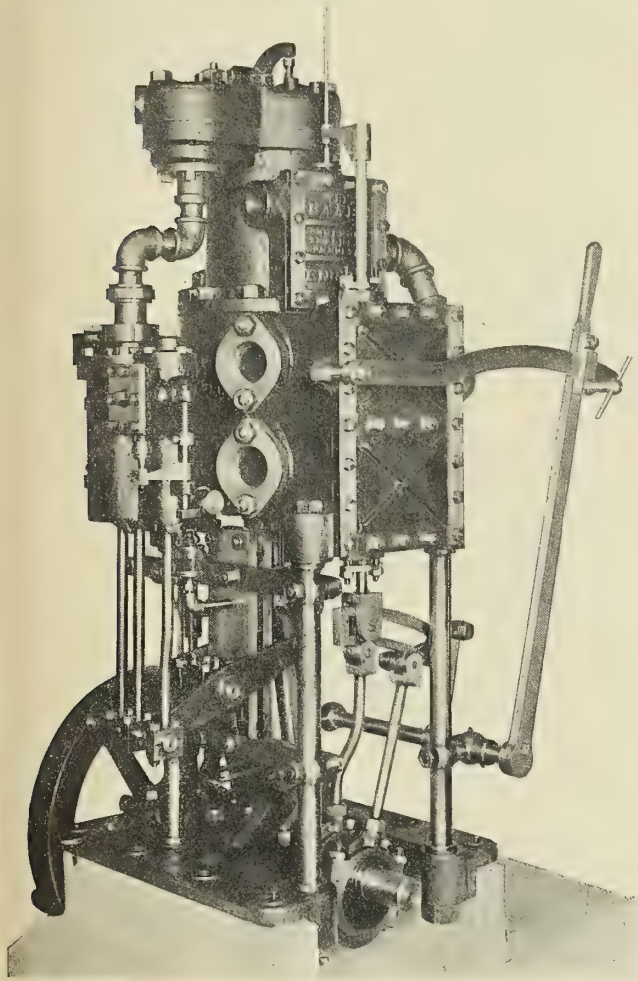


FORE-AND-AFT COMPOUND INTERNAL-COMBUSTION ENGINE.

These engines can be built from 20 horse power up to several thousand horse power. For engines of 60 horse power and above no flywheel is provided, as the engine can be started without necessitating the turning over by hand. All bearing surfaces are made extra large, avoiding all possibility of overheating at high speeds, even with moderate lubrication. The engines are especially well suited for direct-connected units for isolated electric lighting. Being double acting, the rotary

motion is very regular, unlike the engines of the two- and four-cycle type. The exhaust is absolutely noiseless without the use of a muffler, owing to the fact that the gases are expanded down to atmospheric pressure.

These engines are built by the M. and R. Engineering Company, 202 West 103d street, New York, builders of the two and four-cycle types of gas engines for marine, industrial, and automobile use.

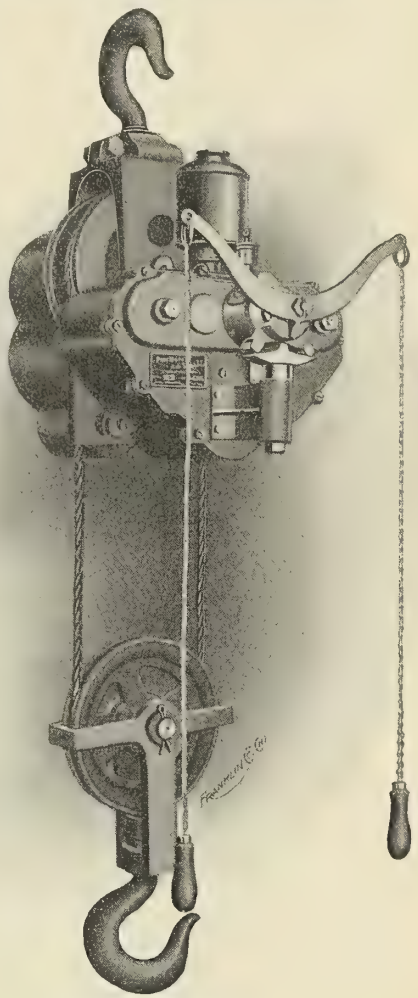


STEEPLE INTERNAL-COMBUSTION COMPOUND ENGINE.

A Pneumatic Hoist.

The value of compressed-air apparatus, such as hoists, drills, and cranes, depends almost entirely upon the quality and economy of the motors. The machine here illustrated is the Port Huron pneumatic motor hoist. The engine consists of two oscillating double-acting cylinders set at right angles in an air-tight case. There is no movable valve mechanism, as the oscillation of the cylinders opens and closes the ports and gives clean cut-off. The cylinders oscillate from the extreme end and there are eight ports for each. When the engine is on dead center the air is all shut off, and when she starts the feed and exhaust ports start to open, and when on half stroke the ports are wide open, gradually closing until dead center is reached. A small quantity of oil is kept in the case, so that the crank revolving lubricates itself and dashes the oil to the valve seats.

The motor handles the load of the hoist through straight line gearing, and is controlled from the crane by two chains. The motor may be instantly started, stopped, or reversed, and is operated by a three-way valve, which is kept tight by a stuffing box. The valve is self-closing when the chains which operate it are released. A wire rope is used on the winding drum, as it runs smoothly and raises the load without jar, which is the case when a chain is used. The ball bearings are bushed with phosphor bronze and the gears are of cut steel, and all parts are made interchangeable.



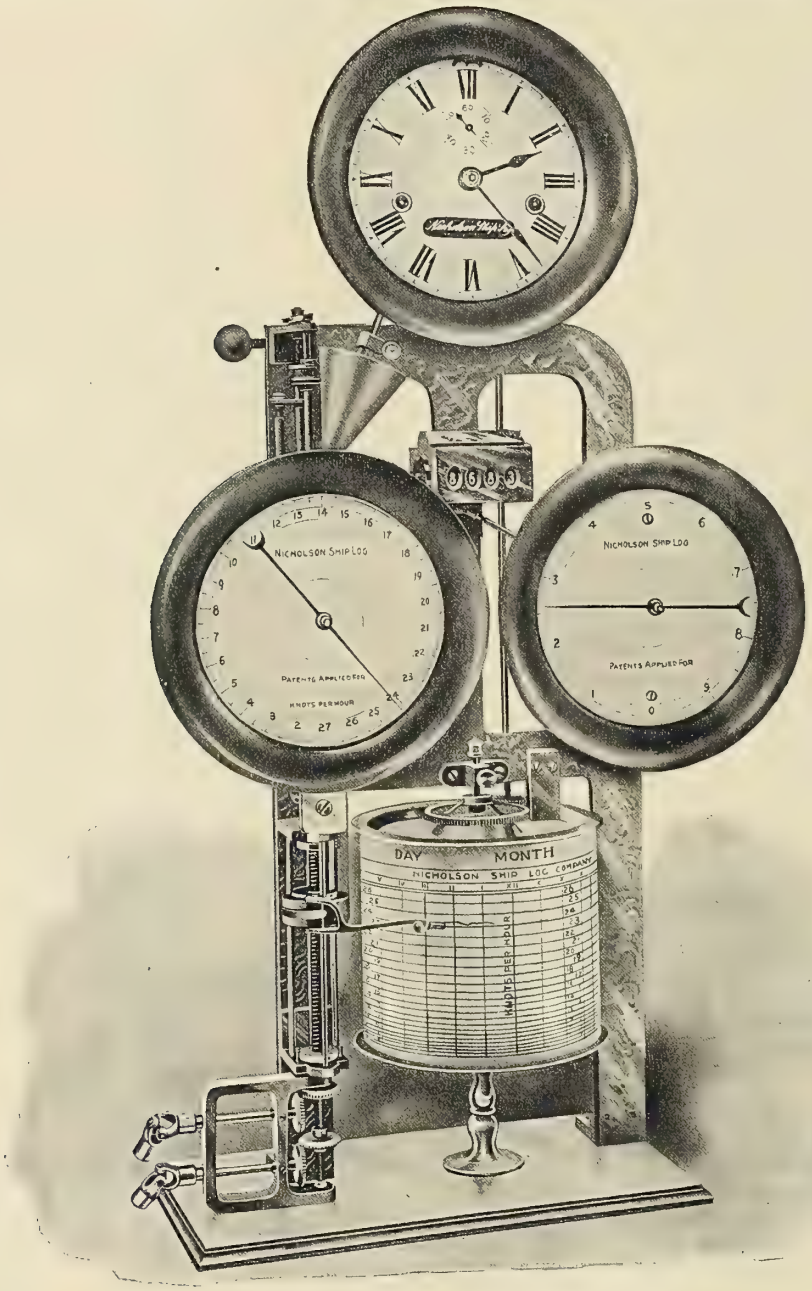
PNEUMATIC MOTOR HOIST.

A four-chain hoist running all day will not consume the air that an ordinary chipping hammer will require, for the reason that no matter how much material is handled with the hoist the latter is actually working but a small percentage of the time. The hoist is made in sizes from one to ten tons capacity, and many of them are now in use. For further particulars address the Port Huron Air Tool Company, Port Huron, Mich.

The Perfected Ship Log.

In the Nicholson ship log is found a mechanism which reliably and accurately records the speed of a vessel and which is not influenced by conditions of weather. No floating log is required, as the mechanism is all contained within the ship itself. The principle of the device is the variation in the height of a column of water, the

lower end of which, extending through the bottom of the vessel, is exposed to the pressure of the outside water due to the speed of the ship. A float in this column of water indicates the speed. This briefly is the principle, but in carrying it out intricate problems had to be dealt with. One of these was to compensate for the level of the water in this tube due to different draft of the vessel, intake pipes, which are 1 inch diameter. Pipe B, which we will call the recording pipe, is closed at the bottom, but has a small hole on the forward side. Pipe A does not extend outside the line of the hull. The upper ends of these two pipes are connected to two 3-inch stand pipes, and as the speed of the ship increases the water level in pipe B rises. The water level of



RECORDING DIALS OF THE NICHOLSON SHIP LOG.

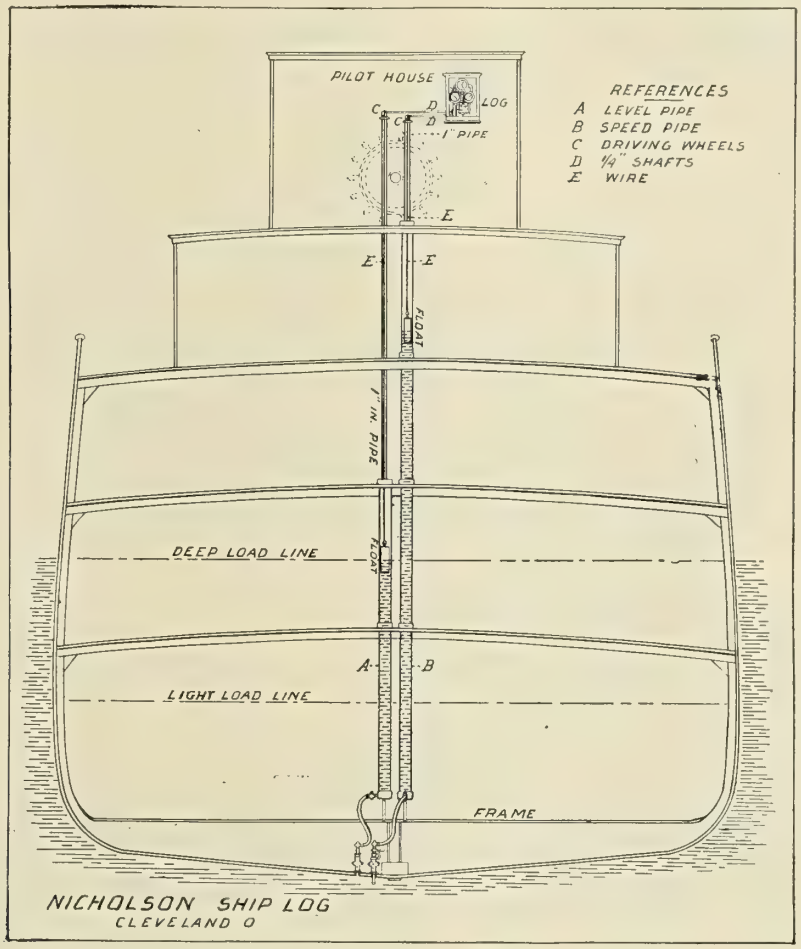
light or loaded. This is accomplished by placing a second tube opening to the outside water at the bottom of the vessel, but not subjected to any forward pressure. Thus the speed of the ship is measured by the difference in level of the two columns, the latter column being called the draft regulator. Two seacocks are placed on the bottom of the vessel, preferably near the center line, and fitted with stuffing boxes through which are run the pipe A, however, depends only upon the draft of the vessel. Floats are placed in each pipe and the two cords are led to the tops of the pipes, wrapped around two wheels, and kept tight by counterweights. The shafts of these wheels are connected through universal joints to the actuating device shown at the lower left-hand corner of the above cut. These two motions drive a compensating screw with ball bearings, so that when

both shafts are turned the same number of turns there is no change of the recording levers. This happens when the vessel is in dock being loaded or when pitching or rolling at sea.

Turning now to the recording device, it will be seen in the cut that above all is a clock. To the left is a dial indicating the speed; in the middle is a counter which adds up the number of miles traveled; to the left is a speed indicator showing the fractions of a mile, and at the bottom is a revolving cylinder on which a record is made of the speed during twenty-four hours. The three latter dials are operated by the clock.

It was found by experiment that the height of the water in tube B varied as the square of the speed; therefore it was necessary to have specially-constructed gearing for the speed indicator, so that each mile could be shown by the same increment of space on the dial. It will be noted that this gearing is above the drum recorder, and upon the latter the vertical distances which represent the speeds are laid off according to the squares of the numbers. The compensating nut carries an arm which draws the curve of speed and to this nut is attached a vertical lever driving the gears above mentioned. These gears operate the speed dial and also through a rack and pinion move the point of contact up and down the speed cone, shown at the upper left-hand side, which is driven by the clock. This friction will actuate the counter, and the indicator at the right hand.

It will thus be seen that all the necessary indications and records of a ship's speed are obtained, and in practice it has been found that the mechanism works with extreme accuracy. Indeed, slight variations in speed, caused by turning of the rudder, are clearly shown and a speed curve is secured of such refinement as never before known. This log has been placed on several Lake steamers and is now being installed on the Coast. It is made in several forms, the simplest of which is the speed indicator alone. Further particulars can be had by addressing the Nicholson Ship Log Company, Cleveland, Ohio.

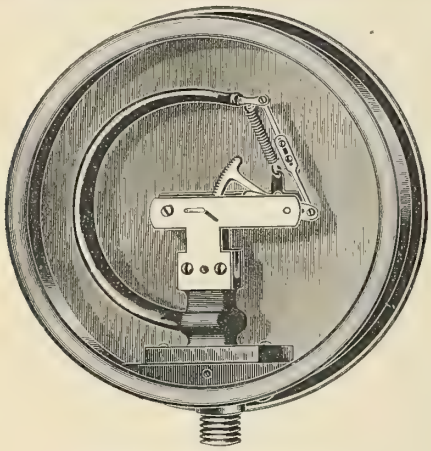


ARRANGEMENT OF PIPES FOR RECORDING SHIP LOG.

Pressure and Vacuum Gages.

These gages are of the well-known Bourdon spring type, with springs of solid drawn tube. This principle is acknowledged as the best for commercial purposes for indicating pressure. A so-called angular independent or suspended movement is employed on all these gages. The original type of movement made first in 1853 is necessarily fastened to the back of the gage case. This is a defect acknowledged by all who are versed in the manufacture of gages, as it has many objectionable features: First, in screwing the gage to pipe connection it strains the movement and often throws the rod

connecting the free end of the tube with the segment out of line, and no gage can be correct after this has occurred. Second, the unequal expansion and contrac-



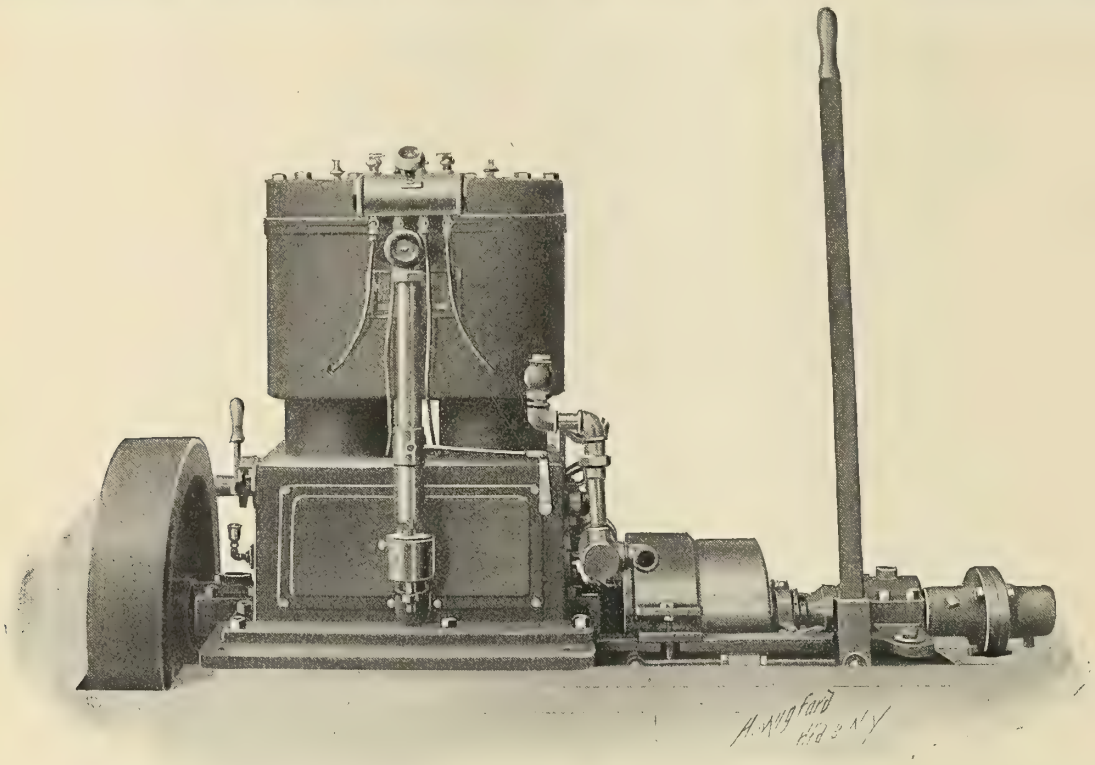
PRESSURE AND VACUUM GAGE.

tion of the metal case and movement is a serious defect when the latter is held in position by being screwed to the back of the case; the old types of movement expand more or less, particularly when exposed to heat, which is the case in many instances, and this means a false indication, and it is not long before the gage becomes seriously defective and unreliable. The construction of the independent or suspended movement is such that it provides a free air space, and comes in contact with the case at one point only, namely, at bottom or side, and not at two points as in the old construction.

Movement plates and segments are made from a special composition, after particular attention has been given to its wearing qualities. Pinions and arbors are made from either German silver or "silver metal," both being strictly non-corrosive. The last-named metal is highly recommended for this purpose, inasmuch as it has tensile strength and wearing qualities equal to, if not greater than, steel. Attention is also called to two new lists in gage prices, namely, aluminum and "silver metal" cases; the advantage of the former will be readily seen from the fact of its extreme lightness. Silver metal cases are recommended where a very rich and superb finish is desired. It takes the place of nickel plating, with the advantage that it will never wear off or tarnish and is not affected by acids or ammonia. These gages are all graduated from an open mercury column U. S. Government Standard 14.7 pounds to the atmosphere and warranted correct. Dials may be furnished in white enamel, silver, or black finish. Further information may be obtained from the Standard Gage Manufacturing Company, of Syracuse, N. Y.

New Marine Gasoline Engine.

The Mianus Motor Works, Mianus, Conn., has placed on the market a new 12-horse-power four-cycle gasoline engine of the marine type. This engine is made from new patterns and designs, and is remarkable for its simplicity and neatness of design. The particular points of excellence are the easy starting device, the largest size motors being started with a lever without touching the flywheel or cranking; the ignition is adjustable with a hand lever, so that any lead may be obtained instantly; oiling is accomplished by a reservoir system of lubrication which is similar



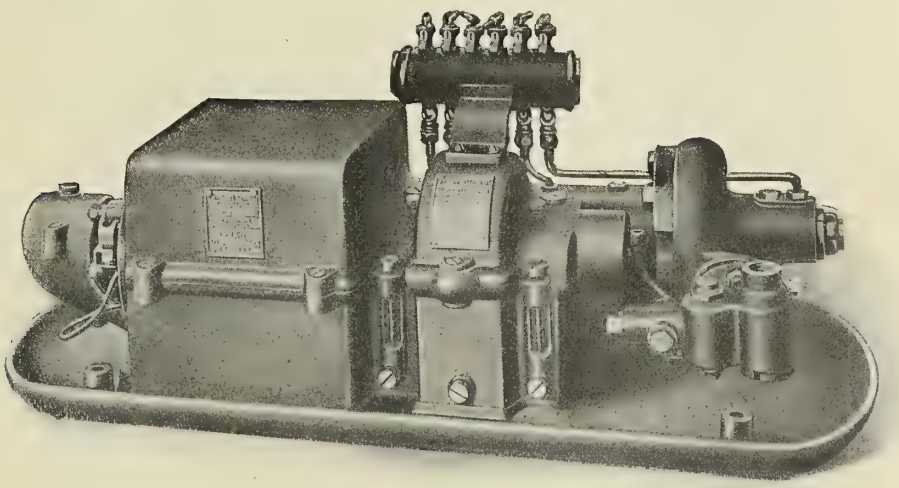
NEW TYPE MARINE GASOLINE ENGINE.

to the best practice in steam engines; the admission of gas is controlled by a throttle valve, so that any speed may be obtained; and reversing is accomplished by a strong reversing gear constructed to carry double the load necessary.

Searchlight Generating Set.

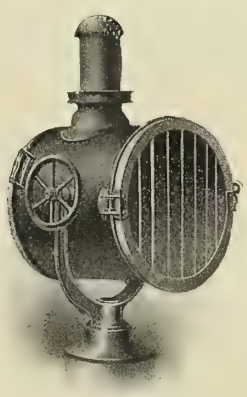
The advantages of the searchlight for use on harbor and river craft and pleasure yachts is already generally recognized, but the size of the generating set prevents in many cases its adoption.

Where electric lighting is used on small vessels the generator will be too small for running an arc light in addition to the incandescent lamps, or, if the generator is large enough for supplying current to both, it is too large to run economically when operating only the incandescent lights.



TURBINE-DRIVEN GENERATING SET FOR SEARCHLIGHT.

The little De Laval generating set here illustrated is built specially for this class of work and embodies features entirely new in this class of machinery. In



IMPROVED SEARCHLIGHT.

place of the ordinary reciprocating engine a De Laval steam turbine is used, which in the cut is seen placed at the right hand. Steam enters through a governor into one nozzle and drives the turbine at a speed of 45,000 revolutions per minute. The generator shaft, geared down 10 to 1, turns 4,500 revolutions per minute. Oiling is entirely automatic through pipes from the oil cup on top, no cylinder oil being required.

The generator, made by the General Incandescent Company, can be wound for either high or low voltage. On a test of one of these little machines 1 1-2 brake horse power is claimed to have been developed on 50 pounds steam per brake horse power, which is a very great saving over other turbines of this small size. The searchlight is built especially for very hard service and the lamp is constructed to withstand any amount of shaking and vibration, no clamps or outside levers are used, and the carbons will burn without renewing for forty-eight hours. The feeding device is governed by a solenoid. A Mangam mirror reflects the beam, so that boats may be detected for over a mile distance. The focus may be adjusted by a thumbscrew at the top of the lamp. This outfit is entirely complete in itself, and all that is necessary is to make the steam connection and connect the terminals of the dynamo with the lamp. The set may be placed in any convenient or out-of-the-way corner. The oil pan at the bottom is but 27 inches long and 11 inches broad, and the total height is 11 inches.

Further particulars may be had by addressing the New York Electric Headlight and Train-Lighting Company, agents of the De Laval Company, 52 Broadway, New York city.

Taylor Water-Tube Boiler.

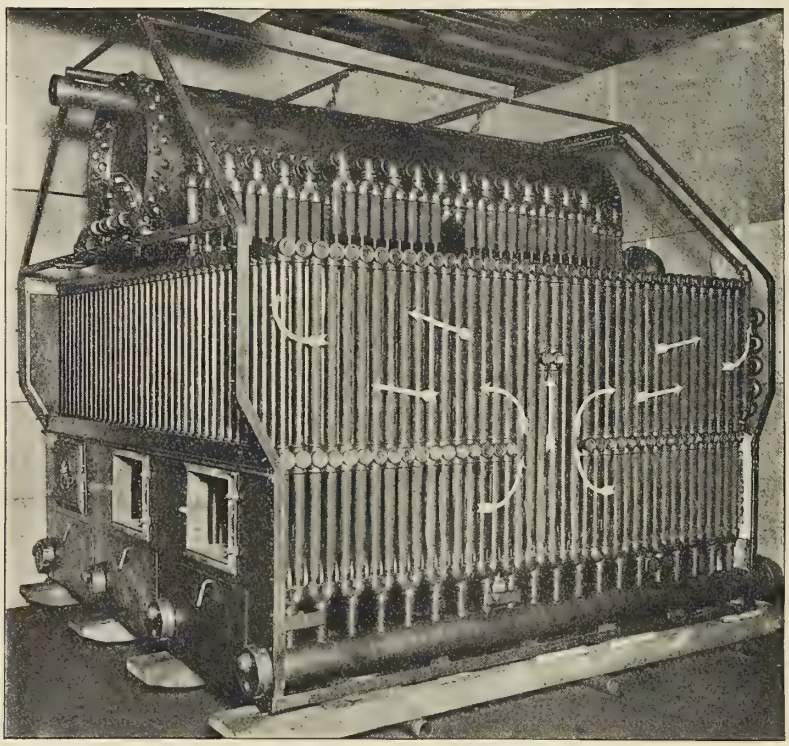
The Taylor water-tube boiler here illustrated is radically different from the usual type of marine boilers, both in the way the furnace gases are handled and in its extremely short circulation. The advantages claimed for this boiler are a well-designed firebox, good combustion chamber, long and definite course for the furnace gases, and one in which the water tubes are so arranged that the steam finds ready access to the drum without displacing the water in the tubes.

The boiler differs much in construction from others which have screwed connections, as all the generating tubes are vertical, except the horizontal headers above

the grates and above the combustion chamber. It is termed a sectional boiler, as it is built up of sections of tubes rather than separate tubes, and this is made the claim for ease of repair.

In general the boiler consists of a large number of short straight vertical water tubes over the fire, connected with headers, which in turn are connected with manifolds at the bottom and a steam and water drum extending lengthwise of the boiler at the top. As shown in the accompanying engraving, there are four large bottom manifolds reaching from front to rear of the boiler at some distance below the grate. From these, two or four down-flow pipes arise outside the casing and connect with the drum below the water line. Connection is also made with the bottom manifolds by vertical pipes spaced widely apart, which at the grate level are screwed into branch connections, from which the pipes are then carried up in pairs and connected with tees and four-way fittings with the nests of generating tubes, which occupy the space all above the combustion chamber and below the drum and form the principal heating surface of the boiler. These rows of tubes, rising from the bottom manifolds and extending from back to front of the boiler, divide the furnace into three grates, for each of which a door is provided in the casing. The tubes composing the generating system are in short lengths and are fastened together by nipples which are screwed into the end connections, the latter being faced and butted up tightly, so as to protect the threads from the action of the fire, and forming top and bottom headers. Between the drum and the casing on each side—one tube for each section—two rows of tubes extend upward from the generating nests and connect by bends with the drum. The connections at the lower ends of the generating tubes are arranged to form the crown sheet in such a way as to compel the gases to travel in the course indicated by the arrows in the drawing, which is somewhat the same in general direction as in the cylindrical double-end marine boiler. At each end of the section manifolds or headers a plug is fitted, which on removal permits of examination and cleaning of these manifolds.

In the steam-generating tubes the circulation is not all in one direction; in some the flow is upward and in others downward, the pipes above the nests of tubes, with outlets into the drum, carrying up comparatively little water to the drum. Inside the drum there is fitted a dry pipe and separator, connecting on the outside with the boiler stop valve, and it is claimed by the manufacturers that their boiler is notable for furnishing dry steam. This boiler has been installed on several yachts and other vessels. The builder is the Taylor Water-Tube Boiler Company, 345 Franklin street, Detroit, Mich.



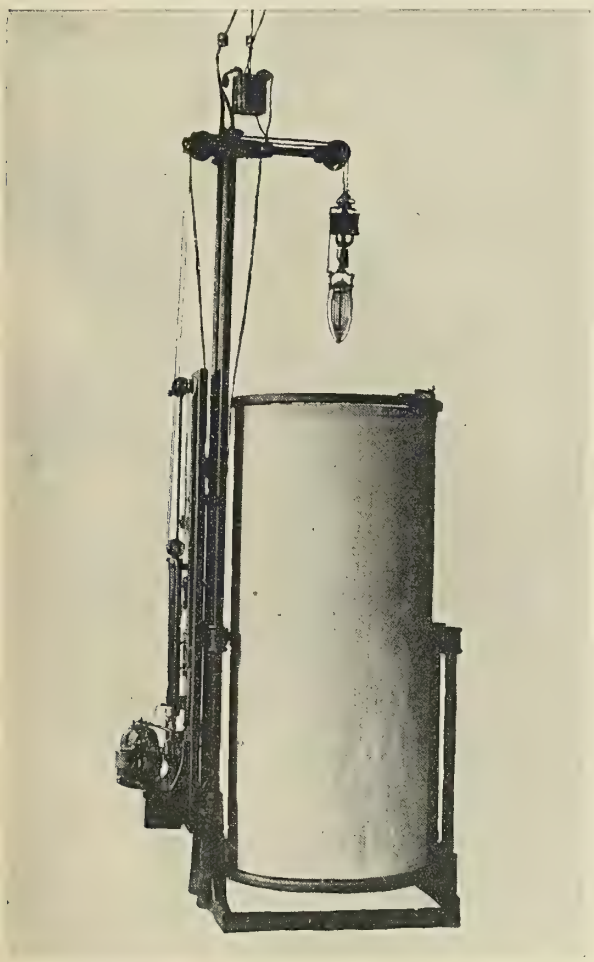
WATER-TUBE BOILER OF THE STRAIGHT-TUBE TYPE.

Electric Blue-Print Machine.

Those having to make blue prints realize the loss of time and money incurred by relying upon the sun's rays for exposures of the sensitive paper. The electrical blue-printing machine is now well established, as this may work on cloudy as well as sunny days, when the operation of blue printing may be carried on wherever the machine may be erected. The apparatus here illustrated consists of a cylindrical printing frame, composed of two heavy curved plates of glass bedded in soft material in an adjustable though rigid frame, together with two tubular uprights which support the arc lamp and automatic drive mechanism. This drive operates the lamp, having means for lowering it through

the cylinder and then automatically raising it again to its former position. The cylindrical frame revolves on trunnions, so that it can be swung to a horizontal position, which is the most convenient method for inserting or removing tracings and paper from the frame.

In operating, the cylinder is revolved to a horizontal position and the tracing and sensitized paper are placed around the outside of the cylinder, being confined by stout canvas covers, which are drawn tight by turning a lever, thus insuring perfect contact between tracings, sensitized paper, and the glass. The cylinder is then swung to the opposite horizontal position and the same



MACHINE FOR BLUE PRINTING BY ELECTRIC LIGHT.

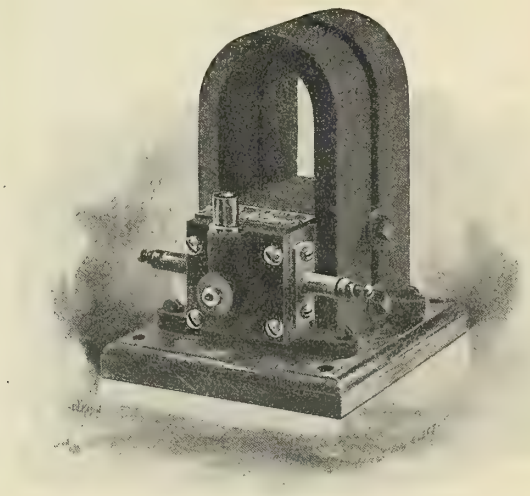
manipulation repeated, after which it is returned and locked in vertical position and is ready for printing. By simply touching a lever the arc lamp starts in its descent through the center of the cylinder at a speed which can be regulated to suit the sensitiveness of paper employed. When the lamp has reached the lowest point of printing surface, it automatically reverses its motion and quickly returns to its original position above the cylinder.

These machines are entirely self-contained, no brackets or pulleys on the walls or ceilings being required. Further particulars may be had by addressing the manufacturer, the Eugene Dietzgen Company, 119 West Twenty-third street, New York city.

Direct-Current Magneto.

Although the magneto used in connection with the ordinary spark coil for gas-engine ignition is a small machine, its proper design and construction require much care, for the machine must run under the most disadvantageous conditions and must run at all times.

The magneto here illustrated is made by the Remy Electric Company, of Anderson, Ind., and was designed especially for use in connection with launch and automobile engines. The magneto is mounted either on a solid base, as shown in the illustration, or with a shifting base when a friction drive is used. The magnetos used in this M.V. type are made from the best American magnet steel, which has the highest magnetic density to insure permanent retention of magnetism. The armature is of the iron-clad, laminated-core, drum type, wound with double steel-covered magnet wire. The lead wires from the coil to the commutator are encased in sleeves, after which they are bound down, shellacked, and baked, making the armature similar to that of high-voltage machines. The commutator is much larger than usual in proportion to the size of the machine and is arranged on a steel core and insulated throughout with mica. In low-voltage machines special attention must be given the selection of a brush, so that the commutator will not be cut. The brushes used are of specially low-resistance carbon.

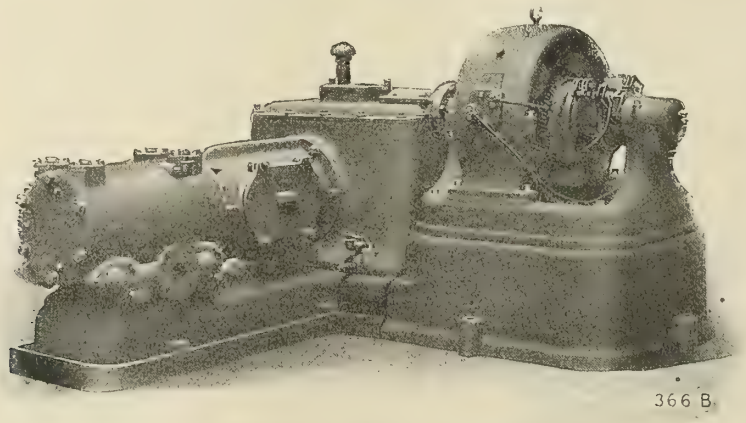


DIRECT-CURRENT MAGNETO SPARKING DEVICE.

Motor-Driven Air Compressors.

Compressed air, which is daily coming into greater use in marine work, is a recognized indispensable agent, and the apparatus which is the simplest and most efficient is, of course, the most desirable. The N. A. Christensen air compressors, made at Milwaukee, Wis., are built specially for small work for both portable and stationary use. The type M motor-driven compressor here illustrated is of the latter class and built in capacities from 50 to 1,000 cubic feet of free air per minute. As will be seen, the electric motor and compressor have been designed to form a compact, self-contained unit. The air is compressed in the cylinders shown at the left. The entire machine is mounted on a substantial cast-

iron base. The cylinder and valve heads are water-jacketed, and clearance spaces are reduced to the lowest practicable limit. The suction and discharge valves, which are interchangeable and of seamless cold-drawn steel, are mounted in cast-iron heads and each is removable independently of the other. No springs are used to seat the valves, they being operated by compressed air and gravity. The piston is provided with improved form of packing rings. The piston rod is of steel and passes through a self-adjusting metallic packing box. The connecting rod is also of steel. The crosshead is fitted with adjustable shoes of large area and with a hardened tool-steel wrist pin, accurately ground and bearing in phosphor bronze boxes on the rod. The crank shaft, of high-grade steel, is extended at the motor end to carry the gear, which is driven by a pinion on the armature shaft of the motor. The gear and pinion are of the helical herringbone type. The gear case and crank chamber are connected, forming an enclosure which is partly filled with oil by the revolutions of the crank. All lubrication is secured by the oil in this chamber.

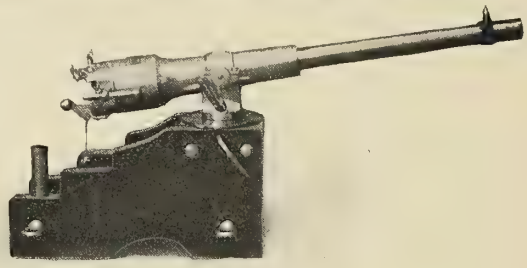


A MOTOR-DRIVEN AIR COMPRESSOR.

Either an alternating or a continuous-current motor may be used, the illustration herewith showing one of a continuous-current, multipolar type. As much care has been given to the design of the motor as to any other part of the machine, and throughout the design of the unit is such that every part is easily and quickly accessible. An automatic governor starts and stops the motor compressor at the desired minimum and maximum pressures. This consists of an ordinary pressure clutch mechanism with a special hand, which, upon coming in contact with a connecting stud at the position of minimum pressure, allows the current to flow through a magnet coil. This coil operates a plunger to which the contact pieces over the motor circuit are attached, thereby closing the circuit and starting the motor. When the pressure reaches the desired maximum this hand strikes another stud and the current passes through a second solenoid magnet, thereby pulling the plunger in the opposite direction and opening the motor circuit. Various types of motors are made by this company for stationary and portable uses.

Signal Gun.

A good gun is a necessity to every well-ordered yacht, yacht club, or steamship. Naval architects and designers generally will welcome any improvements on the clumsy and antiquated style of gun heretofore in



A NEW SIGNAL GUN.

use. The cannon shown in the accompanying illustration is a new type, similar and embodying the good points of modern naval ordnance. This style of deck carriage mount is of mahogany and polished bronze, with ball-bearing rollers—a commendable feature, permitting of movement in any direction, as, with the regular high, conical, bronze deck stands with which these cannon are ordinarily supplied, this gun can be elevated and depressed and pointed in any direction, the carriage remaining stationary. The gun and carriage are separate for convenience in stowing.

A large variety of sizes appropriate for sailing vessels are supplied by the makers, the Naval Electric Company, 95 Liberty street, New York city.

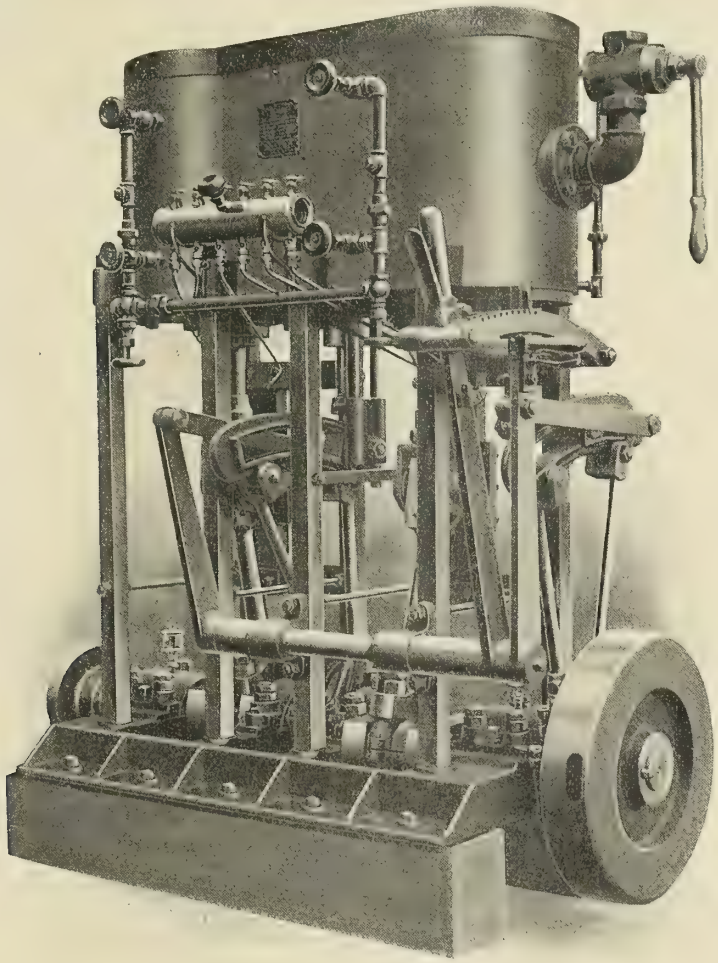
Japanese-Built American Gunboat.—The first of an order of five gunboats for service in the Philippine Islands and built in Japan was launched on October 16. The vessel was christened the *Remblon*.

Steam Turbine.—Mr. John Jacob Astor has advised the public through the *Scientific American* that he relinquishes all claims to his patents on his steam turbine which recently were granted him. He hopes that this act will result in the advancement of the steam turbine for marine and other purposes.

The Reeves Compound Marine Engine.

In the accompanying illustration will be seen a view of the Reeves standard marine compound engine, made by the Reeves Engine Company, Trenton, N. J., which embodies several novel features. One of these is the elimination of the receiver from the cylinders, whereby most economical results are claimed. The materials used throughout are of the very best, cylinders being made in one casting of very close grain charcoal iron. Counterbalances are placed on the crank webs and the patented adjustable type, working in seats having milled ports. Either end of these valves can be adjusted without removing the valve from the seat, by simply removing the bonnet, which permits the adjustment to be made in a very few moments. In a later issue we shall describe this valve in detail.

Another simple but efficient device is applied to the reversing gear, whereby the cut-off in the high-pressure cylinder may be regulated according to the needs of the work and still permit the low-pressure to be run at



COMPOUND MARINE ENGINE.

shaft is made from one forging, of open-hearth steel. The pistons are of cast iron, well ribbed and braced, and the rods are carefully turned from high-grade steel and ground to size. They are fitted to the piston heads on tapers and secured by lock nuts, and are fastened to the crossheads by long threads and held by jam nuts. The crossheads are of the box pattern, with ample wearing surfaces, which are faced with anti-friction metal. Connecting rods are of forged steel, the upper end being solid and fitted with bronze boxes; the crank ends are made of steel castings lined with babbitt metal. Means are provided for correctly adjusting wearing surfaces.

The valves used in these engines are of the Reeves

a fixed cut-off, thus maintaining the same economy as where a governor is used.

This is accomplished by having the reversing arm operating the links of the high-pressure cylinder loose upon the reversing shaft and so that it may be set at any point of cut-off. The main lever, which is connected to the low-pressure gear, automatically picks up and carries the cut-off lever of the high pressure with it, wherever the latter may be set when the engine is thrown over from either direction. These levers remain securely locked together until the admission valve is wanted for cut-off purposes.

TECHNICAL PUBLICATIONS.

Mackrow's Naval Architect's Pocket Book. By Clement Mackrow. Size, 4 by 6 1-2 inches; pp. 750, with numerous cuts and diagrams. D. Van Nostrand Company, New York. Price $5.

The practical architect and engineer demands every possible aid which may serve to shorten the routine computations which he is required to carry out. To this end, slide rules, planimeters, tabular information of every character, and handbooks filled with formulæ, convenient tables, and other aids—these all form a necessary feature of the modern office outfit. Perhaps foremost in importance among these is the pocket book of formulæ and useful information. No one can be expected to remember the manifold formulæ and methods relating to the various problems with which he is called upon to deal. The original literature relating to these various operations is scattered through a dozen sets of engineering transactions and other technical publications, and the purpose of the handbook is to avoid the necessity of too frequent reference to these original sources. It is intended to be the digested product of a library of technical literature. In the field of marine construction Mackrow's pocket book has come to fill this requirement in a very satisfactory manner. Where the field to be covered is so vast, the selection and arrangement of the matter will naturally depend much upon the individuality of the compiler and upon his judgment regarding the information most likely to be of practical use. The present is the eighth edition of this work, so well known as to require no detailed description. Comparing it with earlier editions, we find evidence of revision and of some considerable increase in the amount of matter; in all, some fifty pages have been added. The intention has been to bring the matter down to date and make it representative of the present condition of science in marine construction. The subjects dealt with are grouped systematically under distinct headings, so as to facilitate reference apart from the index, and, as in recent editions, the various tables are placed together at the end of the volume. In the successive revisions of this work special attention has been given to the general subject of the strength of vessels and to the elementary problems relating to the strength of materials, bending moments, shearing stresses, etc., with special regard to their application to such problems. In some respects the revision might, perhaps, have been more thorough, and data and information relating to ships having now only historical interest might have been omitted or replaced by information relating to the modern fleet. Thus on pages 133 and 134 are found a series of particulars, including coefficients of performance, relating to English naval ships dating back as far as the sixties of the last century. Most of these have small interest for the modern designer, and their place might have been acceptably taken by more modern information. In several other places of the book similar out-of-date information is to be found. Taken as a whole, however, the compilation generally shows good judgment, and the compiler has succeeded in bringing together a vast amount of useful information in a form convenient for use in a drawing office, without reference to original authorities. As with all books of this type, it must be used with judgment. It does not pretend to give demonstrations or reasons; it gives simply methods and information. These must be applied with discriminating judgment. Under this limitation the field of usefulness for such books is great, and we can recommend this as a mine of useful information to all who are engaged in this field of engineering practice.

Lucas' Questions and Answers for Marine Engineers, with Chapter on Breakdowns at Sea. By Theodore Lucas. Size 5 by 7 1-2 inches, pp. 507, with 188 figures in the text and twelve folding plates. New York, Theodore Audel and Company. Price $2.00.

The catechism form of text book for self-study has proved its usefulness so thoroughly that it has come to be one of the standard forms of aid for those who wish to prepare in this manner for advancement in the ranks of the operative engineer. Most of the text books available for such study have been hitherto of English publication, and therefore in some respects not directly adapted to the uses of engineers in the United States. This lack has been made good by the publication of the present book, the purpose of which is to help in this manner the engineer who is trying to help himself. The work as a whole is divided into two main parts relating to construction and operation. Otherwise, in relation to subject matter, the book is divided into nine parts and twenty-seven chapters, giving convenient headings and sub-divisions for the various items to be considered.

Part one takes up fundamental principles, combustion and fuel, steam and its properties, mechanics and the economics of the marine engine. Part two takes up in detail the steam boiler and steam generation; part three, the marine steam engine; part four, paddle wheels and propellers; part five, auxiliaries; part six, piping; part seven, care and operation of marine machinery; part eight, breakdowns and repairs; part nine, materials and strength.

The treatment of the subject is simple, instructive, and generally clear. Occasionally the necessary brevity interferes with the fuller treatment which the author would doubtless have been glad to give had the limits of space permitted. The illustrations as a rule are excellent, and the presswork and binding are in the standard style of the publishers. The book should prove of value to all who are desirous of obtaining brief and simple explanations on most of the topics which concern the marine engineer, in connection with the construction and operation of the machinery which is placed in his care.

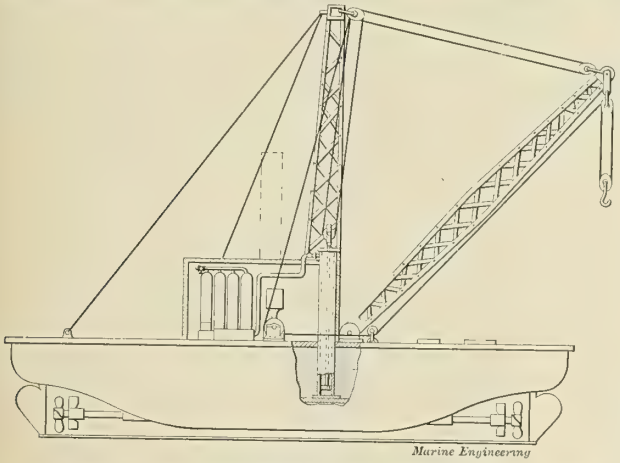
Machine Shop Arithmetic. By Fred H. Colvin and Walter Lee Cheney. Size 4 by 6 inches, pp. 131. Price 50 cents. New York: The Derry-Collard Co.

This little book is intended as a convenient pocket companion to the mechanic and to provide him with simple discussions of many of the every-day shop problems which arise, and to provide accurate and rapid methods for their solution. Instead of furnishing a bare rule, the purpose of the authors has been to furnish, as well, an explanation in clear language of the principles on which the method of solution is founded. Speeds of drills, taps, and milling cutters, emery wheels and grindstones, figuring change gears for screw cutting on lathes, figuring size of drills for holes to be tapped, explanation of the metric system with convenient tables, principles of square and cube root—these are some of

the headings taken at random in turning through the book. The style is clear and instructive, and the book seems well calculated to achieve the purpose held in view by the authors. The index is full and well arranged for handy reference. The entire mechanical make-up of the book is excellent—paper, presswork, and binding—and it may be cordially recommended to those for whom it was intended.

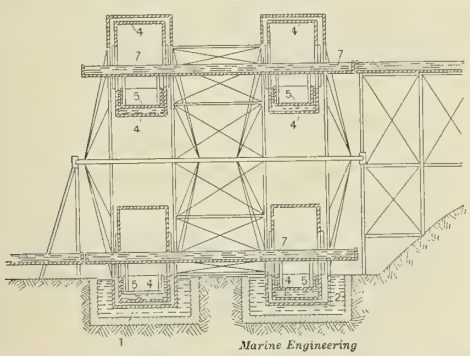
SELECTED MARINE PATENTS.

710,472. HOISTING APPARATUS FOR WRECKING VESSELS. SIMON LAKE, NEW YORK, N. Y. (No model.)



CLAIM.—1. The combination with a floating vessel, of a hoisting line, a sheave pulley suspended from a mast or spar upon said vessel, over which said hoisting line is led, a yielding device operatively connected with said line, a stop shoulder or detent for said yielding device, and means for yieldingly maintaining said device normally in engagement with said stop shoulder or detent in opposition to normal pulls upon said line, but permitting the same to recede from said stop shoulder or detent under a predetermined maximum pull upon said line. Twelve claims.

710,635. APPARATUS FOR RAISING OR LOWERING CANALBOATS, ETC. AUGUST UMLAUF, VIENNA, AUSTRIA-HUNGARY, ASSIGNOR TO FIRM OF VEREINIGTE MASCHINENFABRIK AUGSBURG UND MASCHINENBAUGESELLSCHAFT NURNBERG A. G., NUREMBERG, GERMANY.

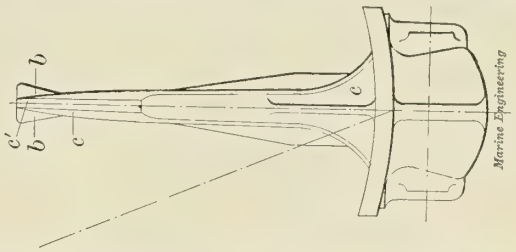


CLAIM.—1. A lifting or raising apparatus in which the water chamber for carrying the load itself is formed so as to float, comprising an annular vessel 1 floating in a basin 2, said vessel having pairs of fixed rolling drums 4 arranged diametrically opposite to one another and filled with water up to a suitable level, in which drums pontoons 5 carrying water chambers 7 float, so that the pontoons always stand horizontally and are raised or lowered on the rotation of the annular vessel 1. Two claims.

711,021. REVERSIBLE PROPELLER. STORER W. THAXTER, BANGOR, ME.

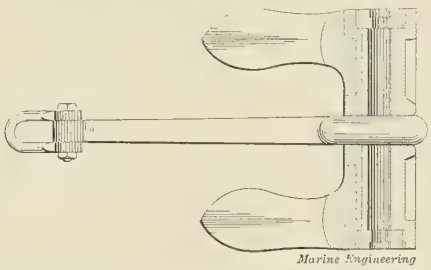
CLAIM.—1. In a reversible propeller the combination of two propeller blades having their shanks shaped and adapted to socket together in a bore in a block or bearing, each shank having an annular circumferential groove near the junction of the shank and blade; a block or bearing bored to receive said shanks of said blades and having two smaller bores at right angles to said first bore concentric with the grooves in said shanks, and two lockpins adapted to fit said two bores and said grooves. Two claims.

710,825. SHIP'S ANCHOR. WILLIAM W. WHITE, NEW YORK, N. Y., ANCILLARY EXECUTOR OF JOHN VERITY, DECEASED.



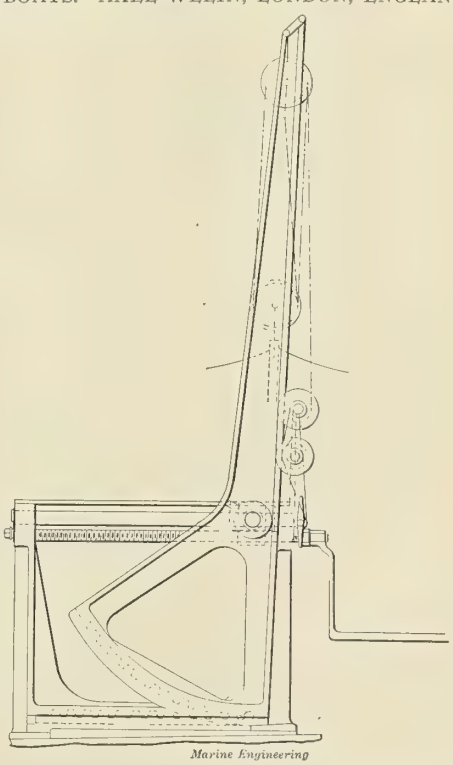
CLAIM.—In a ship's anchor of the kind herein referred to the flukes *c*, with heart-shaped fluke-tips *c'*, disposed in the general plane of said flukes, and projecting cuneiform ribs *b* on either side of the tips *c'*, said ribs forming a flat surface at the end of the fluke-tips *c'* and extending at each side at right angles to the plane of same, and tapering inward toward the surface of the tip. One claim.

710,918. ANCHOR. JAMES P. S. LAWRANCE, U. S. NAVY, ASSIGNOR OF ONE-HALF TO THOMAS BURD ZELL, CHESTER, PA.



CLAIM.—1. The combination in an anchor of the shank, a pair of flukes, a shaft or spindle formed integral with the shank and supporting the flukes, said flukes having hubs extending from the shank to the ends of the shafts and being permitted to oscillate with respect to the shank, means carried by said flukes and coacting with the shaft or spindle for limiting the movement of the flukes, and means for securing said flukes to the shafts or spindles, said flukes having recessed portions for the reception of the securing means. Four claims.

711,749. APPARATUS FOR RAISING OR LOWERING SHIPS' BOATS. AXEL WELIN, LONDON, ENGLAND.



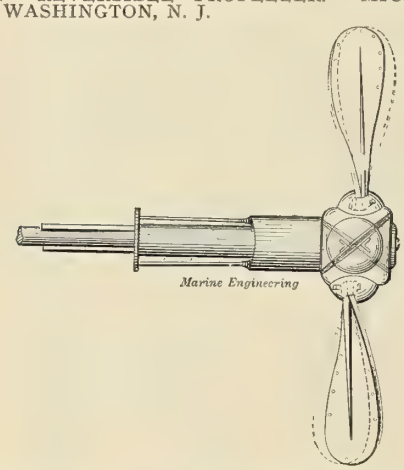
CLAIM.—1. The combination of a davit free to turn in a vertical plane, a pulley carried by its upper end, an attachment for carrying a boat, a rope passing over the pulley and supporting the attachment, a pulley fixed to the vessel around which the rope

passes, and means carried by the davit for drawing the rope over the pulleys as the davit moves outboard. Four claims.

711,884. STEERING PROPELLER. VICTOR SJOSTROM, LOS ANGELES, CAL.

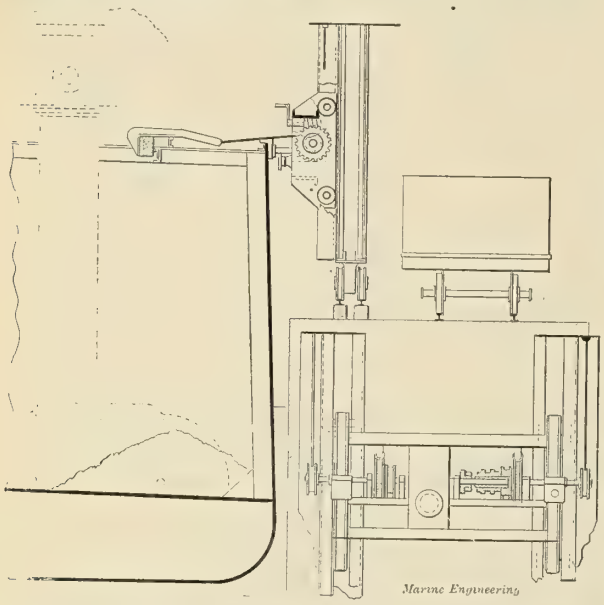
CLAIM.—1. The steering propeller consisting of a revolving cylindrical casing, the spiral blades within said casing, the outer pivotally-mounted cylindrical casing, the antifrictional rollers in recesses having inclined sides, the movable rings, the projecting rim on the outside of the cylindrical casing and the rings maintained at the requisite distance therefrom, the whole being attached to the stern of a ship and all operating in the manner and for the purposes substantially as hereinbefore set forth. Five claims.

712,123. REVERSIBLE PROPELLER. MICHAEL H. DEPUE, WASHINGTON, N. J.



CLAIM.—1. In a reversible propeller, the combination with a propeller shaft of reversible blades mounted thereon, and operating means for reversing some of the blades independently of the other blades, or all of the blades together, said means comprising a sectional sleeve, means for independently or jointly operating the parts of the sleeve, and connections between the parts of the sleeve and blades to oscillate said blades when said sleeve sections are operated, substantially as specified. Four claims.

712,215. VESSEL-HOLDING DEVICE. GEORGE E. TITCOMB, CLEVELAND, O.



CLAIM.—1. The combination with a ship-unloading apparatus having a leg movable parallel with the dock edge, of a vertically-movable clamp carried thereby and adapted to engage the ship and prevent it from moving toward or from the unloading apparatus, substantially as described.

2. The combination with a ship-unloading apparatus having a leg movable parallel with the dock edge, of a vertically-movable trolley carried thereby, a strut carried by said trolley and adapted to engage the side of a ship, and means carried by the trolley and adapted to engage the end of a hatch opening and hold the ship against said strut, substantially as described. Eighteen claims.

712,369. FLUID-PRESSURE TURBINE. HUGH F. FULLAGAR, NEWCASTLE-UPON-TYNE, ENGLAND.

Fourteen claims.

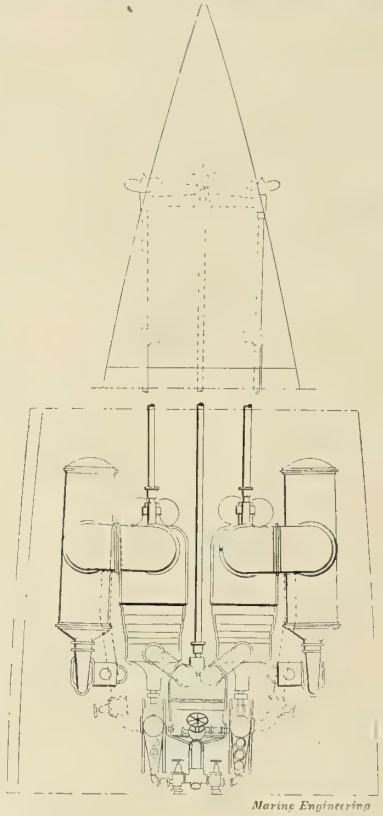
712,424. REVERSIBLE STEAM TURBINE. HENRY F. TYZACK, GATESHEAD, ENGLAND, ASSIGNOR OF TWO-THIRDS TO HENRY SHADFORTH SCOTT, GATESHEAD, ENGLAND, AND ISIDOR SUMMERFIELD, NEWCASTLE-UPON-TYNE, ENGLAND.

Three claims.

712,677. MARINE PROPULSION. ROBERT B. HEWSON, SAN FRANCISCO, CAL.

Six claims.

712,713. PROPULSION OF STEAM VESSELS. CHARLES A. PARSONS, NEWCASTLE-UPON-TYNE, ENGLAND.



CLAIM.—1. A system of engines for propelling steam vessels, comprising a reciprocating engine adapted to propel the vessel at cruising speeds, a turbine engine adapted to alone propel the vessel at full speed, shafting to which the engines are connected, and condenser means to produce condenser-vacuum, in which the turbine runs idly when the reciprocating engine is alone employed for propelling the vessel at cruising speeds, substantially as described. Seven claims.

712,814. BATTERY INSTALLATION FOR SUBMARINE BOATS. SIMON LAKE, BRIDGEPORT, CONN.

Nine claims.

Oil Fuel.—Oil has been adopted for fuel in both the Cramp shipyard at Philadelphia and the Townsend-Downey yard on Shooters Island. At the latter yard oil has been used in the plate furnaces for several months.

Coaling Warships.—The British Admiralty recently fitted out at Portsmouth a vessel to act as a floating coal depot. She was built with large hoppers, so arranged that coal might be withdrawn from the bottom. Owing to the weight of coal above the hoppers, the openings clogged up and were only cleared with difficulty. The Admiralty has brought out new designs, in which these difficulties have been overcome, and many firms have been asked to bid on two coaling vessels of 12,000 tons each. The hulls are divided into immense holds from the lower deck up. In the lower decks are chutes through which the coal falls by gravity into the bags fixed below. These bags are then conveyed to hoists in the central passage, raised and unloaded from the deck into the vessels alongside.

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" 94, George R. Jones, Box 222, Washington, N. C.
" 95, A. P. Jerguson, Box 95, Key West, Fla.
" 100, Jas. P. Lynch, Honolulu, H. I.
" 101, Thos. J. Hanlon, Box 765, Norfolk, Va.
" 102, Chas. La Bounty, Box 563, So. Haven, Mich.
" 103, C. H. Hall, Box 512, New Berne, N. C.
" 104, J. H. Blumer, Moss Point, Miss.

TRADE PUBLICATIONS.

The gas engines of the Mianus Motor Works. Mianus, Conn., are described and illustrated in a six-page folder which is being distributed. The various features which are most important in an engine are referred to, such as ignition, lubrication, accessibility of parts, etc.

The last public address of President McKinley, delivered at the Pan-American Exposition, Buffalo, on September 5th, and an address entitled "Our Place Among Nations," delivered by President Roosevelt in Boston on April 30th, have been republished in pamphlet form. Copies can be had from M. H. Tarbox, treasurer of the Boston and Lockport Block Co., Boston, Mass.

The punching and shearing machinery manufactured by the Long and Allstatter Company, Hamilton, Ohio, is fully described in a large and fine catalogue just issued, known as No. 20. This catalogue is 6 by 9 inches in size and contains 160 pages, showing in great variety the punching and shearing machinery which this company manufactures, including also bending and forming machines, bending rolls, drop hammers, etc.

The White marine gasoline engine manufactured by the Globe Iron Works Company, 2425 University avenue, S. E., Minneapolis, Minn., is described in a thirty-page catalogue now being distributed. The catalogue is well printed on heavy coated paper and contains quite a number of illustrations of the engine, and the various features of the engine are fully described. The pictures show engines from about one horse-power to the two-cylinder engines of thirty or more horse-power. There are also a number of pictures of hulls of different types manufactured by this company, from small launches up to boats 50 feet or more in length.

Oil as Fuel, Its Advantages for Shops and Manufacturing Plants, is the title of a paper-bound book issued by the Railway Materials Company, Old Colony Building, Chicago, Ill. The subject of oil as fuel, not only in manufacturing plants, but on board vessels, is receiving a great deal of attention, and is one of much interest to those of our readers connected with both shipyards and the operation of vessels. In this booklet are pictures of furnaces of various sorts, such as for welding flues, heating rivets, forging furnaces, annealing furnaces for boiler shops and the like. This company also makes a device of great value in shipbuilding work in the form of a portable heater.

The De Laval steam turbine is described in a very handsome catalogue which has just been issued by the De Laval Steam Turbine Company, 74 Cortlandt street, New York City. This turbine is very fully illustrated and described, and its operation is shown by handsome engravings, which explain in much detail its operation. Several combinations of this turbine, in direct connected and belted work, are fully illustrated and described. These include electric plants, blower outfits, pumps in several forms, fire equipments, marine generating sets and launch turbines. Altogether the catalogue is one of exceptional interest because of the great attention which turbines are now attracting. Copies can be had upon application to the company.

Small electric storage batteries for use where a limited amount of power is wanted, such as operating miniature electric lamps, for sparking gas engines, for electric bells for launches and vessels, fan motors, small lighting plants, portable lighting outfits, etc., are fully described in the cataogue isued by the United States Battery Company, 552 State street, Brooklyn, N. Y. The catalogue is very neatly printed, and much information is given regarding the design and construction of these batteries, and a number of practical tests are described. Pictures are given of individual batteries, as well as several plants in which a large number of batteries are combined. Any one interested in the subject of small power and light devices will find the literature of this company very valuable.

The vertical double-acting air pump and jet condenser, manufactured by Dean Bros.' Steam Pump Works, Indianapolis, Ind., is described in a twelve-page booklet just issued, as are also several other pumps of this company's make. On each page is a large picture of some sort, and accompanying it is brief descriptive matter.

Users of boats for launches, ship's boats or other purposes will be interested in a folder issued by Fred Medart, St. Louis, Mo., describing knock-down boats and complete sets of boat hull frames, of which he makes a specialty. A number of illustrations show different types of boats sold in this manner, and there is considerable information regarding material.

Engineering Periodicals and the Card Index is the title to a pamphlet issued by H. W. Hibbard, Ithaca, N. Y. It is the reprint of an address delivered before the students at the Society of Mechanical Engineers at Cornell University. It explains the advantages of systematic reading of current literature, and argues for the use of the individual card index.

The American separators and exhaust heads have a neat catalogue, pocket size, devoted to them and now being sent out by the manufacturer, Whitlock Coil Pipe Company, Elmwood, Conn. This catalogue is printed in two colors, and contains illustrations of the specialties referred to. The text is made easy for reference because of side headings. Copies of this catalogue and of others relating to the many specialties of this company can be had upon application.

Applications of Lundell Motors and Direct-Current Generators of the Split-Pole Type are the titles to two new bulletins which have been issued by the Sprague Electric Company, 527 West Thirty-fourth street, New York City. All of the bulletins issued by this company are exceedingly valuable, as each one takes up a specific subject. Each bulletin is very thoroughly illustrated with the very best of engravings, and contains the necessary descriptive matter to fully cover the subject. Wherever they are useful there are tables of various sorts, together with many line drawings of sectional views, etc. The subject of direct connected motors for running machinery has become an important one, and all our readers will find both of these bulletins well worth careful study.

Refrigerating machines are very thoroughly described and well illustrated in a catalogue that is being distributed by the American-Linde Refrigeration Company, 45 Broadway, New York. The catalogue is well printed on heavy paper and comprises 78 pages, with cover. There are several pictures of the machines manufactured by this company, together with sectional views of parts, folded insets, to explain more fully the text, together with much other valuable information. There are also lists of concerns which use this company's machines, together with tables regarding chloride of calcium, tables of brine solution, comparison of thermometers, properties of ammonia gas, properties of steam, etc. We infer that copies of the catalogue can be had by referring to MARINE ENGINEERING.

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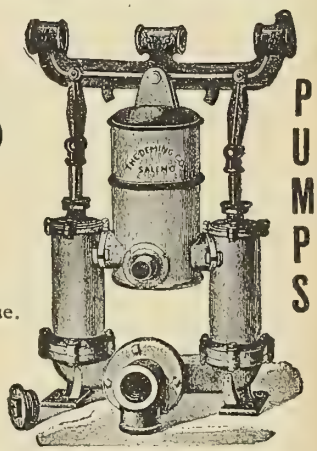

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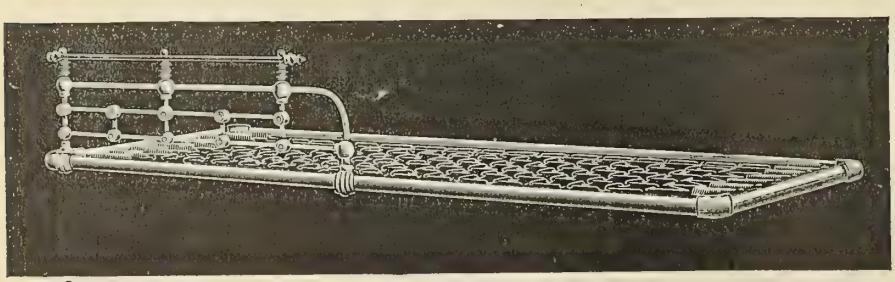

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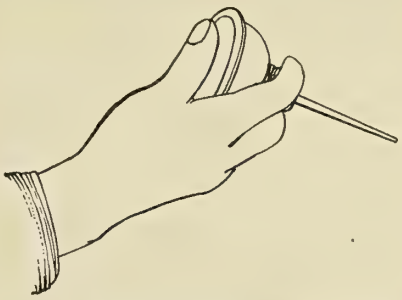

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For valves and cylinders and all bearings there is nothing to equal Dixon's graphite. Sample free.

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FERGUSON PORTABLE HEATER.—The catalogue of the Railway Materials Company, Old Colony Building, Chicago, shows a cut of the Ferguson portable heater. The device consists of a tank, mounted on wheels, to hold twenty gallons of fuel or crude oil; the controlling valve for the atomizing device; the hose necessary to make air connection, and the burner. It is a portable and very compact apparatus. The hose is connected to the compressed air plant, and air is admitted to the tank. The vaporized oil and air pass out through a line of hose to the burner. This device is extensively used by railways for steel car repairs or heating heavy bent material. The vaporizing is believed to be as near perfect as possible, and the heater is capable of heating large material to a high heat. It is an excellent device for shipyards, being portable, and it is possible to run the tank to any part of the yard, the only necessity being sufficient air hose. No material is too heavy to be heated by this machine.

Pan-American Medal.—The Ross Valve Company, Troy, N. Y., announces on a neat card that it received a "Medal, and the Ross water engine is the only one receiving an award at the Pan-American Exposition."

The igniting dynamos manufactured by the Dayton Electrical Manufacturing Company, Dayton, Ohio, have a neat folder devoted to them. These dynamos and attachments are built especially for use in connection with gas engines for launches and other purposes, and their construction and manner of operation is fully described.

An electric hoisting plant for discharging vessels, recently erected by the C. W. Hunt Company, West New Brighton, Staten Island, is described in a pamphlet now issued by this company. The plant is illustrated and a few features and figures regarding the plant are given, showing comparative cost of operation, as well as manner of operation, etc.

Asbesto-Metallic Kearsarge and Wound Cloth Packing is the title to a booklet just published by the H. W. Johns Manufacturing Company, 100 William street, New York City. The number of illustrations shows the different manner in which this material is made up and the adaptability of it for enginering purposes is briefly stated. Any one who wishes packing in any form will want to send for a copy.

Higher Efficiency and Economy in Mechanical Advertising is the title to a booklet issued by Clarence P. Day, Postal Telegraph Building, New York City, who has just opened an office as advertising counsellor or specialist. Mr. Day has been connected with technical journalism for eighteen years, and, with his knowledge of mediums and methods, has published this booklet, which contains much valuable information for any one who is doing advertising or who contemplates undertaking it. The book is very neatly printed and is thoroughly divided for purposes of reference by means of side-headings. It contains much practical information regarding the subject of spending an appropriation account. We understand that copies of the booklet can be had by referring to MARINE ENGINEERING.

Water and Gas Work Appliances and Pumping Machinery is the title of a very handsomely printed and cloth-bound catalogue, 9 by 10 inches in size, which has just been issued by R. D. Wood and Company, 400 Chestnut street, Philadelphia, Pa. The catalogue is even more comprehensive than its title indicates, for not only are the several specialties referred to fully illustrated and described, but also large hydraulic riveters, together with many other tools and all sorts of auxiliaries for use in connection with hydraulic machinery, etc. The catalogue comprises 175 pages, and naturally there is a great deal of valuable information on subjects pertaining to the line of manufactures of this company. The completeness of the catalogue probably limits it to a very select circulation, as it is evidently a very expensive book to issue.

Walworth Mfg. Co., 130-136 Federal St. BOSTON

Specialty of BRASS VALVES and Fittings for Marine Construction

Extra Heavy Valves, Bent Pipe and Fittings for High Pressure Work

Sole Manufacturers of

Van Stone Pipe Joint

Which does not Weep under heavy pressure

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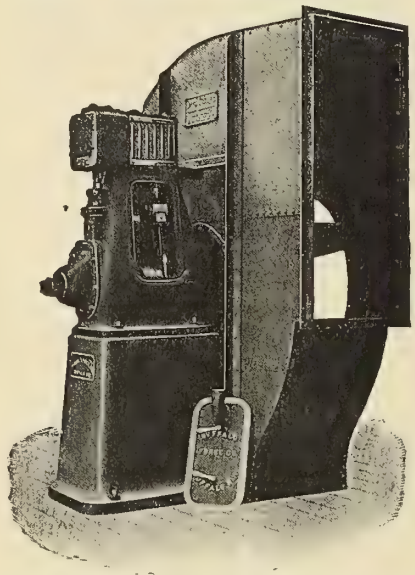

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has been used in American paint combinations for over fifty years, and these have been successful in proportion to the zinc contained; but zinc white has rarely received the credit. The American is not a Hindu, and it is time he knew that good paint always contains **Zinc White.**

FREE: OUR PRACTICAL PAMPHLETS,
"The Paint Question."
"Paints in Architecture."

THE NEW JERSEY ZINC COMP'Y
11 Broadway, New York

Calendars for 1902.

The Ashton Valve Company, 271 Franklin street, Boston, Mass., issues a calendar lithographed in black, referring briefly to this company's pop safety valves and pressure and vacuum gauges. There is a sheet for each month, and the calendar is made effective by a lithograph of "La Mademoiselle." It is stated on the back that a copy of this calendar can be obtained by sending 10 cents to this company.

The Eagle Oil and Supply Company, 104 Broad street, Boston, Mass., now has a calendar for 1902 ready. The list of customers of this company is so large that the company is unable to meet the demands. The company's customers have already been provided for, and requests from other parties will be filled as promptly as possible. So many calls have been received that it is almost necessary for the company to ask that 10 cents be sent in stamps for postage. The calendar is a very handsome one, comprising twelve sheets, one for each month, and there is a different picture on each sheet. The sheets are printed in three colors.

BUSINESS NOTES.

BOYER WATER TUBE BOILERS.—The United States steamship *Georgetown*, that has recently been built for the United States Government, is fitted with Boyer patented sectional water tube boilers which were manufactured by John E. Thropp and Sons Company, Trenton, N. J., for L. Boyer's Sons, 90 Water street, New York. The boiler occupies a space 66 by 96 inches, has a heating surface of 1,400 square feet and a grate surface of 30 square feet. The boilers weigh 12,500 pounds, and the water weight is 1,950 pounds. The boilers furnish steam for two triple expansion engines 7 x 10 x 15 inches by 8 inches, making 350 revolutions.

NEW LATHE PLANT.—It is announced that the American Turret Lathe Manufacturing Company will remove its plant from Wilmington, Del., to Warren, Pa. Work has already been begun on the new plant. The plans provide for an erecting shop 60 by 300, fitting rooms, storerooms, machine shop, power house, forge shop, offices, etc., giving a total of 75,000 square feet of floor area. All of the buildings will be one-story high and thoroughly lighted. In every particular the plant will be one of the most modern in construction and equipment that can be built. In addition to the lathes which the company now manufactures, the business will be extended to include other types of lathes, duplex milling machines and a variety of other tools. The entire management of the business is in the hands of the president and general manager, C. M. Conradson.

CONSOLIDATION OF ASBESTOS COMPANIES.—It is announced that the H. W. Johns Manufacturing Company, of New York, and the Manville Covering Company, of Milwaukee, Wis., each company having for a long time been closely identified in handling the goods manufactured by the other, have consolidated their interests. The capital stock of the company is $3,000,000, and the new company will be known as the H. W. Johns-Manville Company. The officers of the new company are: T. F. Manville, president; C. B. Manville, vice-president; George W. Gladwin, vice-president; F. R. Boocock, treasurer, and H. E. Manville, secretary. James G. Cannon will be chairman of the board of directors. C. R. Manville will be manager of the western department, and he, with C. B. Manville, will remain in Milwaukee. T. F. Manville and H. E. Manville will remove to New York. The new company is rapidly completing a plant at Milwaukee for the manufacture of carbonate of magnesia and mineral wool. When this plant is completed the company will be prepared to furnish a most complete line of all grades of steam pipe and boiler coverings and asbestos goods of all descriptions.

THE NEW STURTEVANT PLANT.—Work is rapidly progressing upon the foundations for the new plant of the B. F. Sturtevant Co., at Hyde Park, Mass. The buildings, including storage space between, will occupy a tract measuring in extreme dimensions about 500 feet by 700 feet. This will provide space for the foundry, pattern and pattern storage building and power plant as well as the machine shop, 120 feet by 500 feet, and a three story structure of the same length, both terminating in a large head house which will serve for the work of erecting, testing and shipping. The office will be a separate building of considerable dimensions.

PARSON'S MANGANESE BRONZE.—The Taunton-New Bedford Copper Company, New Bedford, Mass., which has a New York office at 77 Water street, and a Boston office at 61 Batterymarch street, is the sole manufacturer under license from Wm. Cramp and Sons' Ship and Engine Building Company for Parson's manganese bronze in this country. It is claimed for this metal that for great tensile strength, elasticity and elongation, coupled with unusual non-corrosive qualities, that it cannot be excelled. This bronze can be forged at a cherry-red heat. It is especially well adapted for hull plates for yachts and launches, and also for pump linings, condensers, rudders and other parts of a ship where non-corrosive qualities are desirable. In addition to being sold in rolled sheeets and plates, it is made in round, square and hexagon rods for studs, bolts, nuts, pump and piston rods, yacht shaftings, etc.

NAVAL ELECTRIC CO.—The Naval Electric Co., 95 Liberty street, New York, is just putting on the market something new in the line of searchlights, which is attracting much attention. This company devotes itself exclusively to marine matters and was first organized to introduce the Yale submarine electric lamp. This is a device which ought to be on board every vessel as well as convenient at every wharf, as it can be used in water for purposes of illumination. The Naval Electric Co. is also making a specialty of telephone, designed especially for use on ship or in other places where there is a large percentage of moisture in the atmosphere and where ordinary telephones will not work. An adaptation of the electric system used has been introduced in connection with submarine boats. This has already been tested and was recently investigated thoroughly by officers of the Imperial Russian Navy. The apparatus used in connection with this consists of a specially constructed kerosene oil engine connected to an electric generator to furnish a current for a number of Yale submarine lamps. The oil for the engine is contained in the base, which is made hollow for this purpose, and the whole set is very compact, permitting it to be placed in an ordinary ship's boat. It can readily be seen that this device can be used for submarine purposes, and in warfare it can be used to protect vessels from the attacks of submarine torpedo boats. This outfit of generating set and submarine lamps, being portable, is made of much value in cases of submarine diving and wreckage.

THRUST BEARINGS.—The Standard Roller Bearing Company, 2328 Market street, Philadelphia, Pa., is meeting with much success in introducing its thrust bearing, which was described in MARINE ENGINEERING for November, 1901. This company makes roller bearings in great variety and for all purposes. A special class of bearings is made for propeller shafts, upright shafts, worm gears, etc. Special bearings are also made to suit special conditions.

A FINE CATALOGUE FREE.—We are informed by M. H. Tarbox, treasurer of the Boston and Lockport Block Company, that he will have ready for delivery in a very short time one of the largest catalogues of blocks ever published. It will be very complete and thoroughly illustrated, and those of our readers who wish to be sure to secure a copy should send in their applications at once. This company is now well settled in its new quarters at 158-160 Commercial street, Boston, Mass., where the entire building, five floors and basement, has been especially fitted up for this company's business. On the first floor are the offices of the company, on the second floor sample room for pumps, trucks, differential hoists, etc.; on the third floor stock room for wooden, iron and steel blocks, and the fourth floor stock room for trucks. The company has greatly increased its stock of pumps and trucks. The company has transferred, as far as possible, its shipping department from the East Boston factory to its new store, thus saving about one day's time in shipments. A branch telephone exchange with two receiving lines has been installed, so that there is always opportunity for telephone communication.

CENTRIFUGAL OIL EXTRACTOR.—The Keystone Engine and Machine Works, Fifth and Buttonwood streets, Philadelphia, Pa., manufactures the well-known Simpson's centrifugal oil extractor. A small folder, issued by this company, states, regarding this extractor: "Extracts oil and foreign matter from the exhaust steam, thereby purifying it so that the water of condensation can be returned to the boilers, and will save from 40 to 60 per cent of the oil fed through the steam cylinder. It is constructed on the only correct principle—that is, separation by centrifugal force. There are no baffle-plates to obstruct the free flow of steam and create back pressure, as the flow of steam is continuous and takes a spiral course to the bottom, distributing the grease and foreign matter on the walls and surfaces during transit. They will be found very useful on any exhaust pipe of engine, and should be placed as near the engine as possible, particularly where it is desirable to use the oil over again. It is very desirable to return the water of condensation to the boiler, because it prevents the formation of scale, and where boilers have scale in them it will soon become soluble and can readily be blown off by the blow-off valve, but where the grease is not taken from the exhaust the water of condensation usually finds its way to the sewer, causing a great loss. No exhaust injector should be used without first passing the steam through the extractor."

MODERN WIRING

Our Flexible Steel Armored Conductors are endorsed by engineers for use in Marine or Ship Wiring, because of the high grade insulation, thorough protection from mechanical and other injuries, entire flexibility and low cost.

Send for descriptive bulletin No. 40115.

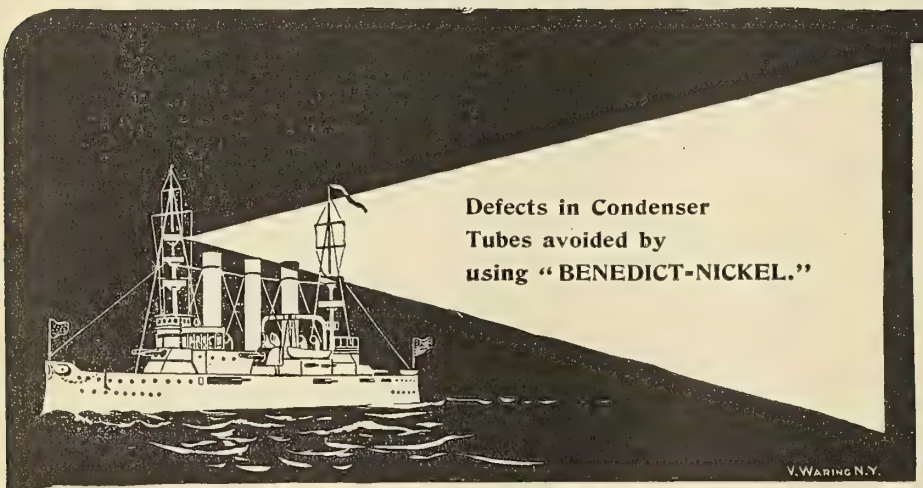
SPRAGUE ELECTRIC COMPANY

General Offices: 527-531 West 34th Street, New York.

BRANCH OFFICES: CHICAGO: Fisher Bldg. ST. LOUIS: Security Bldg. BOSTON: 275 Devonshire Street. BALTIMORE: Maryland Trust Bldg.

ALBERGER CONDENSER COMPANY.—The Alberger Condenser Company is a new company which has just been organized with Louis R. Alberger president, George Q. Palmer vice-president and B. W. Pierson secretary and treasurer. Offices have been opened at 95 Liberty street, New York. For marine service, the new company offers a new system of surface condensation which allows both a reduction in weight and cost of operation. This field is one in which Mr. Alberger has been doing special work for many years. Among the other specialties of the company will be condensing apparatus of all kinds, vacuum pumping machinery and cooling towers. Mr. Alberger was for thirteen years in charge of the condenser department of Henry R. Worthington.

EYNON-EVANS SPECIALTIES.—The Eynon-Evans Mfg. Co., 1515 Clearfield street, Philadelphia, Pa., has recently published catalogue No. 7, containing information regarding the engineers' and machinists' specialties it manufactures. The leading place is given to the Eynon-Korting compound injector, and its special qualities are set forth in a clear and convenient manner. Convenient tables are furnished of capacities for different steam pressure and conditions of use, as an aid to the buyer. This company also makes a leading feature of exhaust steam condensers, both separate and with combined pump. A compact type of surface condenser, the duplex air and circulating pumps is also offered, and this section of the publication is accompanied by a convenient table showing the gain by use of a condenser for engines of varying sizes and piston speed. Another leading feature is made of blowers for handling air and gases under all conditions. The apparatus offered under this head comprises special jet nozzles, belted and direct driven blowers; compressors and special types of exhausters; syphons, jet pumps, valves of various types and for various purposes, special pipe fittings, gauge cocks and various railroad specialties are also listed and described in this publication. Copies can be had free by the asking.



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There is no risk of longitudinal fracture from internal stresses in condenser tubes made from "Benedict-Nickel." The spiral formation produced by our patented hot-rolling process of manufacture makes tubes of extreme strength and toughness, capable of resisting the greatest strain.

The composition of the metal enables "Benedict-Nickel" Seamless Condenser Tubes positively to resist Electrolysis.

Owing to its great density, extreme toughness and perfect homogeneousness, "Benedict-Nickel" can be used of much lighter gauge than brass or copper; consequently its condensing efficiency is much greater.

We are also large manufacturers of seamless brass and copper tubes made by the same process as "Benedict-Nickel."

Tobin Bronze has almost a world-wide reputation for marine purposes. We sell it at manufacturers' prices.

Send for treatise on "Electrolysis of Condenser Tubes."

BENEDICT & BURNHAM MFG. CO.,

Mills and Main Office, Waterbury, Conn.

New York, 253 Broadway. **Boston, 172 High Street.**

V. WARING, N.Y.

"BENEDICT-NICKEL" SEAMLESS TUBING

FIRM OF NAVAL ARCHITECTS.—Swasey, Raymond and Page have opened an office in the Colonial Building, Boston, Mass., as naval architects. Circulars are being sent out announcing that this firm is prepared to design vessels of all types for passenger and freight service, as well as tugs, yachts, etc. All three members of the firm have had experience with leading shipbuilders, and having secured control of the Taunton Yacht Works, Taunton, Mass., have established quite a trade for vessels of the smaller type in construction work. The firm already has in hand several sketches for steam yachts varying in size from 90 to 183 feet. Yachtsmen are invited to inspect these designs.

HEWSON'S STEAM TURBINE.—The Hewson Steam Turbine Company has recently installed an exhibit in the basement of the Bourse, Philadelphia, Pa., which attracts much attention. It consists of one of this company's multiple expansion cut-off steam turbines which operates a dynamo. The claim is made for this turbine that it uses the steam expansively from seven to ten times, and the guarantee is made that the turbine will not exceed 14 pounds of water to the horsepower per hour when running condensing. We understand that a boat has been under operation for some time in San Francisco harbor with one of these turbines for an engine.

FREE CORRESPONDENCE INSTRUCTION.—The American School of Correspondence, 156 Tremont street, Boston, Mass., notifies employers and others interested in the subject of correspondence instruction to inquire regarding the courses at this school. Through the generosity of the founders of the school and others interested, the trustees are enabled to offer each year in the engineering courses a few free scholarships to deserving, energetic and intelligent young men. The scholarships for 1902 are now at the disposal of the trustees, and applications will be considered from the readers of MARINE ENGINEERING. The course of study offers free instruction in marine engineering in all its branches, and includes, also, courses in heating and ventilation, free hand and mechanical drawing, etc.

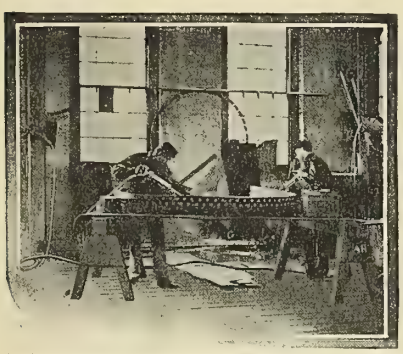
TWO NEW TUGS.—The Johnson Iron Works, New Orleans, La., are building for the Louisiana and Texas Railroad, a branch of the Southern Pacific, two steel tugs 112 feet length over all, 24 feet beam, 11 feet hold, each with two boilers of Scotch type and twin screw non-condensing engines, steam steering gear and steam windlass. Deck and houses of wood. One of these is nearly ready for launching, the other to follow a month later.

A LARGE MARINE RAILWAY.—The H. I. Crandall and Son Co., East Boston, Mass., recently built a large marine railway for W. A. Boole and Sons, San Francisco, Cal. In writing to the Crandall Company last month, the Messrs. Boole reported having just hauled out steamship *Tellus* of 2,522 tons. The steamship had 100 tons of water ballast and 300 tons of rock ballast, making the dead weight lifted over 2,900 tons. This feat attracted much attention on the Pacific coast, as the boat was hauled out in a fractional part of the time that would have been required had she been placed in dry dock.

ECONOMY IN LARGE SCHOONERS.—Frank N. Tandy, 31 State street, Boston, Mass., has recently made some interesting investigations into the subject of economy of large schooners. He has taken the statements of two four-masters and two five-masters which have been used in the Atlantic coast trade. Vessel No. 1 made twelve voyages, consuming 512 days to date. It paid dividends from $16 to $84 per 1-64 each trip, the total for the twelve trips figuring up $442 per 1-64, and she paid 38.8 per cent of her cost in that time. This vessel cost $72,960, gross tonnage is 1,904 and her carrying capacity is 3,000 tons. The three other vessels from whose statements data are compiled paid from $12 to $100 per 1-64 each trip, and the average for the fleet shows a dividend of $33 per 1-64 each trip and a yearly profit of 27.5 per cent on the investment to the owners. The net earnings have so far averaged 42.9 per cent of the gross receipts and 18.9 per cent of the total cost of the vessels has so far been paid.

"LITTLE GIANT" Pneumatic Hammers,

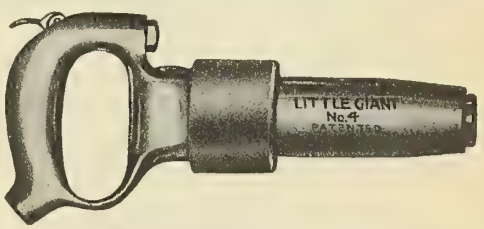
Used extensively in the United States, British, French, German, Russian, Spanish and Italian navy yards, and in the principal ship yards the world over. Greatest time and labor-savers of the 20th Century. Unexcelled for all classes of riveting, chipping, caulking, beading, etc. Made in eight different sizes.



"Little Giant" hammers chipping on steel boiler plate.

No Vibration. No Delicate Parts.

Made to withstand hard service.



Sent on trial. Express paid both ways if not satisfactory. Installation of complete air plants our specialty.

Write for Catalog "F." You will make no mistake if you order a "Little Giant."

Standard Pneumatic Tool Company

Manufacturers of Air Drills, Hammers, Reversible Flue Rolling, Reaming, Tapping and Wood Boring Machines, Motor Chain Hoists, and Pneumatic Tools and Appliances of Every Description.

General Offices and Works AURORA, ILL.

Eastern Offices, 141 Broadway, NEW YORK.

CHANGE OF LOCATION.—The sales offices of the Shelby Steel Tube Co. have been consolidated and transferred to the Empire Building, Pittsburg, Pa., and all orders or communications are hereafter to be sent to the Pittsburg office, as the New York and Chicago offices have been discontinued. The manufacturing facilities of this company are being steadily augmented and the company is now thoroughly equipped to care promptly and satisfactorily for any order. This company's steel tubes have been very extensively used not only in naval work but in much of the best merchant marine work.

THE SPECIALTY PAINT COMPANY.—The Specialty Paint Company, whose office is in the Park Row Building, New York, is meeting with much success in extending the sale of its several specialties. These include marine coating, which is designed to effectually prevent fouling and corrosion on ships' bottoms, marine cement which prevents the crustation of metal and forms a foundation for other paints, and a fireproof paint which has proven very valuable as a fireproof coating on woodwork on board vessels, as well as on wharf building and elsewhere. Further information regarding these specialties can be had from the company.

DOWN-DRAFT FORGE SHOP EQUIPMENT.—Some years ago the Buffalo Forge Company, Buffalo, N. Y., installed for the "Big Four" railroad a down-draft forge shop equipment in the company's shops at Wabash, Ind. Recently, Superintendent of Motive Power Garstang addressed a letter to the Buffalo Forge Company, enclosing copy of a letter to the Embree McClean Carriage Company, St. Louis, Mo., in which he stated: "Our Wabash shop is equipped with the Buffalo Forge Company's down-draft forges, which have been in service now for several years. I consider them a success, and especially so in so far as keeping the shop free from smoke and gas is concerned. For the class of work that I imagine is done in a carriage shop I do not believe there is any forge better adapted for this service than the one in question."

NEW STEAM SPECIALTY FIRM.—M. A. Hudson and H. S. Whitney, formerly connected with one of the largest machinery supply houses in New York, are representing in New York and vicinity the Standard Gauge Manufacturing Company, Syracuse, N. Y.; J. E. Lonergan and Company, Philadelphia, Pa., and the Penberthy Injector Company, Detroit, Mich. They have offices at 141 Broadway.

TUBAL MANGANESE BRONZE.—The tubal manganese bronze manufactured by Paul S. Reeves and Son, Philadelphia, Pa., is proving one of the most desirable metals for use for propellers, piston rods and other such marine uses. The United States Government recently made a test of the castings from this metal, each casting weighing 4,200 pounds. This test gave the following results: Ultimate, 82,340; elastic limit, 33,400; elongation, 31.5; reduction, 31.80. The minimum test was: Ultimate, 78,680; elastic limit, 38,300; elongation, 27; reduction, 27.8. This metal is sold by the Messrs Reeves in ingots or castings up to 20,000 pounds in weight. Users of bronze can readily secure complete data regarding this special make upon inquiry of the manufacturers.

REMARKABLE TRIP OF A LAUNCH.—President P. E. Remington, of the Remington Automobile and Motor Co., Utica, N. Y., in company with L. M. Graham, treasurer, left Utica one Saturday morning in a 20 foot launch equipped with one of this company's standard four horse power motors. Their destination was New York City, and Mr. Graham writes that they reached One Hundred and Fifty-fifth street at 8 o'clock Monday night, making the run of 250 miles in thirty hours running time. The trip down the Hudson River in such a small boat was somewhat perilous, as both wind and tide were against them much of the time. This will show that the boat made an average speed of little over eight miles an hour. No trouble was experienced with the motor in this long run, and Mr. Graham states that so far as he could determine the motor did not miss a spark from the time he left Utica and arrived in New York.

STANDARD SEAMLESS TUBE CO.

MANUFACTURERS OF

Seamless Cold Drawn Steel Tubing

In all sizes from ⅛ to 16 inches diameter.

BOILER TUBES
FOR ALL CLASSES OF MARINE WORK

Stay Tubes. Water Grates. Compressed Air and High Steam Pressures.

Hollow Shafts, Bushings, Hydraulic Tubes, etc., etc.

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PAN-AMERICAN HONORS.—Charles J. Bogue, of 217 Centre street, New York City, received honorable mention by the Committee of Awards at the Buffalo Exposition for search lights.

DRILLING MACHINES IN STOCK.—H. G. Barr and Company, Worcester, Mass., carry in stock what is claimed to be the largest line of sensitive drilling machines in the country, comprising sixteen distinct styles. At the present time they report business good. The drills in stock for immediate delivery are two spindle, four spindle, and three styles of single spindle drills; others are on the floor. Readers can write them for prices if they want tools of this kind.

BUCKLEY WATER TUBE BOILERS.—The Rochester Machine Tool Works, Rochester, N. Y., which for many years has been manufacturing the well-known Buckley water tube boilers, has largely increased its facilities for manufacturing these boilers. Mr. Charles V. Grohs has been made secretary of the company. Orders have just been received for two large size boilers which are to go to Seattle, Wash. Last month a duplicate order was received by cable from England for some of these boilers.

NEPTUNE BOILER COMPOUND.—The Engel and Fagersten Chemical Co., 1702 Wabash avenue, Chicago, Ill., announces the receipt of another large order for Neptune Anti-Fouling Compound from the North German Lloyd Steamship Co., also very encouraging reports from tests made on the steamers of the United Fruit Co., as well as by other steamship companies. This company has made a specialty of a compound for boilers where it is necessary at any time to use salt, brackish or sweet water. Full information regarding the compound is sent to all inquirers upon application.

SCHOONER YACHT FOR EMPEROR WILLIAM.—The Townsend and Downey Shipbuilding and Repair Co., whose offices are in the Produce Exchange Building, New York City, recently closed a contract to build a schooner yacht which has been ordered by Emperor William of Germany. The first keel plates were laid early in October and the frame work of the yacht is now pretty well under way. The steel frames are made by the Passaic Iron Works, Passaic, N. J., and the plates are furnished by the Tide Water Steel Co., Chester, Pa.

NEW BOILERS FOR STEAMSHIP NORTHWEST.—The steamship *Northwest*, of the Northern Steamship Company, which runs between Buffalo and Duluth, is to have installed on board this winter a set of Scotch boilers, in place of the Belleville boilers, which have been in use for several years. The new boilers are designed and will be built by the Eastern Shipbuilding Company, New London, Conn., and consist of three double ended boilers, with six furnaces, and four single ended boilers, with three furnaces. The total heating surface is 22,500 square feet, and the total grate surface is 650 square feet. The boilers are to be built for a working pressure of 210 pounds. It is understood that the sister ship, the *Northland*, will have similar boilers installed in the near future.

SPECIAL NOTICES.

Announcements under this heading will be inserted at the uniform rate of thirty-three-and-a-third cents a line. Lines average ten words each.

PERMANENT POSITION WANTED.

A permanent position is desired by a man of the widest experience in naval and mercantile ship and machinery design and construction. Competent and willing to devote his best efforts to the interests of a modern shipyard in the direction of designing, estimating, cost accounting, piece work detailing, increasing the output of men and tools, advertising or specializing on certain classes of work, as required by the policy of the concern. Address, "EARNEST EFFORTS," care Marine Engineering.

GOLD MEDAL FOR MORISON FURNACES.—A gold medal has been awarded the Continental Iron Works, Brooklyn, N. Y., for the Morison Suspension Boiler Furnaces, exhibited at the Pan-American Exposition. These furnaces are in great favor for land and marine boilers. It is claimed that their form of construction offers the greatest possible resistance to distortion or collapse and a freedom from leakage not to be obtained in furnaces which consist of sectional flanged and riveted cylinders, with reinforcing rings interposed between the flanged, or any other method. The Continental Iron Works are the sole manufacturers in this country for the Morison furnaces.

HOT WATER PACKING.—After exhaustive tests covering a period of two years, the H. W. Johns-Manville Co., 100 William street, New York, has placed on the market a packing to be used on plungers and rods of pumps, delivering water at a temperature above 180 degrees F. In every test which has been made this packing is claimed to have lasted six times as long as any other packing subjected to the same conditions. The Kearsarge-Asbesto-Metallic packings produced by this company are meeting with ever-widening favor, and the success of the entire line of packings offered for high pressure and high speed engines is sufficient guarantee of the value of any new packing which may be offered.

HAWKINS' WORKS
for
Progressive Engineers
on
Steam and Electrical
ENGINEERING
6 VOLUMES IN SET FOR $11.
Terms $1.00 a Month.
Write today for particulars
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DIRECT-READING

Voltmeters, Ammeters, Millivoltmeters, Voltammeters, Milliammeters, Ohmmeters, Portable Galvanometers, Ground Detectors and Circuit Testers.

Our Portable Instruments are recognized as **the standard** the world over. Our **Voltmeters** and **Ammeters** are unsurpassed in point of extreme accuracy and lowest consumption of energy.

WESTON ELECTRICAL INSTRUMENT CO.,
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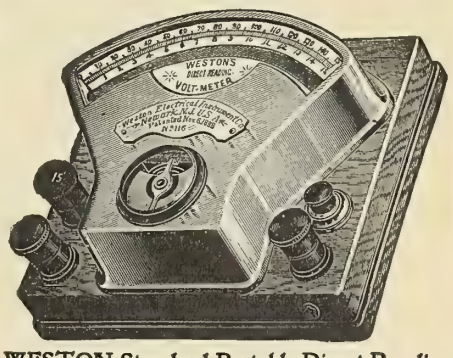


WESTON Standard Portable Direct Reading Voltmeter.

The Peerless Spiral Piston and Valve Rod Packing

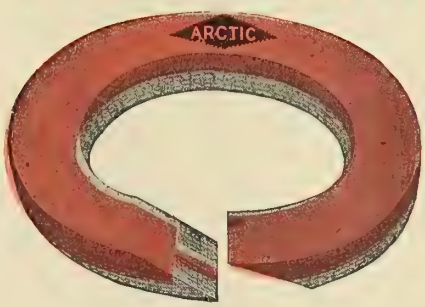
It will hold 400 lbs. of steam

Once tried always used

Will run twelve months in high speed engines

Arctic Packing

To be used exclusively for packing Ammonia Pumps



This packing is made in several hundred sizes

This packing is specially constructed for ice machine service, of layers of rubber and plies of duck which are so arranged and laid as to best resist the actions of ammonia, cold and heat.

The duck is a specially made duck, frictioned with an entirely new compound heretofore unknown to the rubber trade, and the core and back is of the celebrated Rainbow Packing compound, which is specially adapted to resist ammonia, cold and heat.

This packing is constructed on a strictly scientific basis, and the results obtained thus far have demonstrated fully its value for ammonia packing.

This packing is made in several hundred sizes. The rings may be slipped onto the rod very readily.

The usual rule is to be observed in giving measurements, the depth and width of stuffing box and size of piston rod, in order to get the size desired.

Sole Manufacturers of the

Celebrated Rainbow, Eclipse Sectional Rainbow Gasket, Hercules Combination and Honest John Packings.

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" 77, Jos. P. Brewer, 206 N. Ninth St., Manitowoc, Wis.
" 78, Geo. Trevillion, 366 S. Lake Ave., Duluth, Minn.
" 80, R. P. Cook, 46 Elm St., Albany, N. Y.
" 81, Jas. L. Sweeney, 204 E. Saragossa St., Pensacola, Fla.
" 82, Fred H. Gowell, 4227 Middle St., Bath, Me.
" 84, N. K. Ludlow, 15 S. Royal St., Mobile, Ala.
" 85, G. H. Miller, 412 Fifth St., Alpena, Mich.
" 86, Sherman A. Smith, 737 Menekannee Ave., Marinette, Wis.
" 87, Geo. B. Milne, 1003 Trumbull St., Detroit, Mich.
" 88, C. O. Chapman, S. B. Canal, Sturgeon Bay, Wis.
" 89, Geo. A. Tate, 141 North Water St., Ogdensburg, N. Y.
" 91, Robert Davidson, 17 Fairfield Ave., Harbor Sta., Ashtabula, Ohio.
" 92, H. E. McArthur, Courier-Herald Bldg., 3d floor, Saginaw, W. S., Mich.
" 93, M. E. Davis, M. T. & S. Co., 929 D St., N. W., Washington, D. C.
" 94, George R. Jones, Box 222, Washington, N. C.
" 95, A. P. Jerguson, Box 95, Key West, Fla.
" 100, Jas. P. Lynch, Honolulu, H. I.
" 101, Thos. J. Hanlon, Box 765, Norfolk, Va.
" 102, Fred W. Linsemeyer, 210 Clinton St., South Haven, Mich.
" 103, C. H. Hall, Box 512, New Berne, N. C.
" 104, J. H. Blumer, Moss Point, Miss.

TRADE PUBLICATIONS.

The Holland Torpedo Boat Co., Elizabethport, N. J., is desirous of obtaining catalogues and circulars from manufacturers of and dealers in tools and supplies pertaining to machinery and ship work. Catalogues of standard size for filing are preferred.

The Marine Iron Works, Clybourn avenue and Southport street, Chicago, lost all of its catalogues in the fire which destroyed the company's plant several weeks ago, and would like to receive copies of all catalogues and circulars of value to a concern which builds wooden and steel hulls, engines, boilers and other marine specialties.

A neat desk blotter is being distributed by the American Valve Co., Coxsackie, N. Y., upon which are pictures of this company's gate valve disks.

The exhaust heads and steam traps manufactured by the B. F. Sturtevant Co., Jamaica Plain, Mass., are briefly described in catalogue No. 19, which is now being distributed. It comprises eight pages and contains the necessary illustrations and descriptive matter and other data to fully describe each device.

Users of riveting machines will want a copy of the ten-page folder issued by John F. Allen, 370 Gerard avenue, New York City, describing his riveting machines of different types. A number of names of large users of these riveters is given, and a glance at the folder will show that they are of a type which would be very well adapted for use in shipyards, boiler shops, etc.

The universal wood trimmers which the Fox Machine Co., Grand Rapids, Mich., manufactures will be found fully illustrated and described in catalogue No. 16, which is now being distributed. The design and operation of these cutters are fully shown by the many illustrations, and their usefulness in boat shops, pattern shops, joiner shops and other wood-working shops will be readily appreciated. Copies of the catalogue can be had upon application.

Users of wood-working machinery will receive a neat catalogue if they write to the American Machinery Co., Grand Rapids, Mich., and refer to MARINE ENGINEERING, describing the Oliver wood trimmers, universal saw benches and other wood-working tools. This catalogue shows a line of machinery especially adapted for use in launch and yacht building establishments, in pattern shops, joiner shops, etc. The catalogue is very neatly printed on coated paper, and the illustrations are brought out exceptionally well.

The Edwards patent air pump for marine engines is one of the recent specialties of the Wheeler Condenser and Engineering Co., 120 Liberty street, New York. The company is now distributing a catalogue which tells fully about this pump. The catalogue is 6 by 9 inches in size, neatly printed, and contains a number of engravings of pumps showing, by means of sectional views, its construction and manner of operation. The special advantages claimed for this pump are: that there are no foot or bucket valves; that no door is required in the barrel; that few spare parts are required; that all valves are accessible, etc. Copies of the catalogue can be had by addressing the manufacturer.

The twist drills, reamers, chucks, spring cotters, taps, flat spring and rivet keys, milling cutters and other tools which the Standard Tool Co., Cleveland, Ohio, manufactures will be found thoroughly described and completely illustrated in this company's 1902 catalogue. This catalogue comprises 224 pages, and it can be readily seen that it is very thorough and that many specialties are described when it is stated that the index alone covers five pages. Nothing seems to be overlooked which a user of any or of all these specialties would want to know, and, in addition, there are many tables of useful information, so that altogether the catalogue is very valuable to any who use tools or have to do in any way with engineering work.

A Short Story of James Watt and the Steam Engine is the title to an 8-page booklet which Wyman and Gordon, Worcester, Mass., are distributing. On the back page of the booklet is a brief reference to this company's drop forgings and other specialties.

Lundell Electric Motors for Hospital Service is the title to bulletin No. 208, copies of which can be had from the Sprague Electric Co., 527 West Thirty-fourth street, New York City. It refers especially to small electric motors for use in surgical operations and fan motors of different types and sizes.

The National Automatic Lubricator is described in a pocket-size catalogue now being distributed by the National Lubricator Co., Albany, N. Y. A number of illustrations show the design of the lubricator, and the text describes fully the manner of its operation. The sight feet adjustment has separate illustrations and descriptions. Any one interested can have a copy by referring to MARINE ENGINEERING.

Marine engines, hoisting engines, ship windlasses and other specialties manufactured by the Marine Iron Co., Bay City, Mich., will be found described in a special catalogue which this company now has ready for distribution. It is 5 by 8 inches in size, well printed, and contains illustrations of various specialties referred to. Most of the illustrations are of considerable size, and the text is complete, so that each specialty is sufficiently described to give an excellent understanding of it.

Users of portable forges will want to send for a copy of the catalogue issued by the Empire Forge Co., Troy, N. Y., which has just been issued as catalogue No. 29. This business was established in 1835, and the purpose of the company is to manufacture "the best in the world." Especial claim is made for these forges that they are heavy, strong and portable; have bronze bearings; no dead centers; do not use belts, and that there is no back motion; also, that, being made almost entirely of metal, they will wear much longer than most forges, and not be seriously affected by fire and water. Many illustrations show forges for all purposes, and each variety is described by itself. The catalogue comprises 48 pages.

The 1902 Nautical Almanac published by Riggs and Brother, 310 Market street, Philadelphia, Pa., is now ready for distribution, and as no price is mentioned we infer that copies can be had by writing to the company and mentioning MARINE ENGINEERING. The almanac is 6 by 9 inches in size, neatly bound in heavy paper cover, and comprises 162 pages. It contains a vast amount of information regarding nautical subjects, and is, as its name indicates, a thoroughly nautical almanac. There is a great deal of matter in it which every person must know who has anything to do with yachts or vessels of any kind, such, for instance, as information regarding tides, speed trials, distances, measurements, information regarding the sun, moon and stars, pilot matters, rules to prevent collisions at sea, rules for vessels both at sea and inland waters, and the like.

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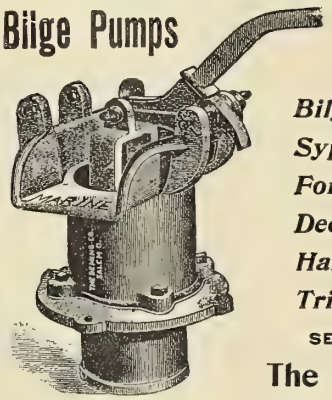

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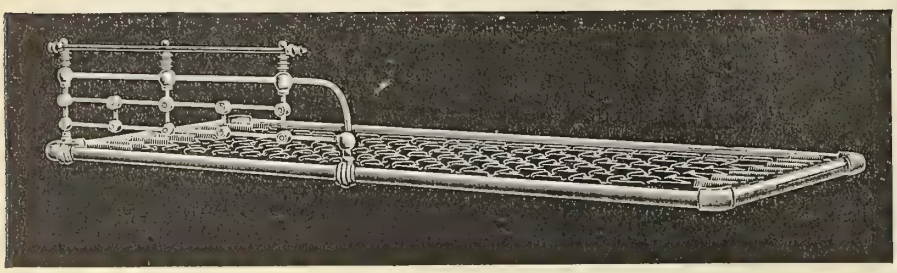

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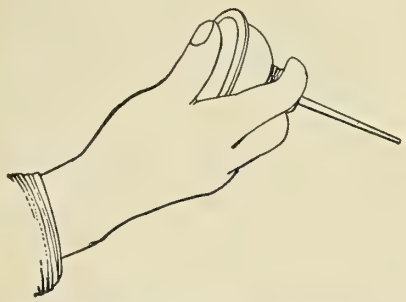

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DIXON'S

Pure Flake

GRAPHITE

in an ordinary

SQUIRT CAN.

For valves and cylinders and all bearings there is nothing to equal Dixon's graphite. Sample free.

JOSEPH DIXON CRUCIBLE CO., JERSEY CITY, N. J.

Cadman's Indestructible Blow-Off Valve is described in catalogue B, copies of which can now be had from A. W. Cadman Manufacturing Co., Pittsburg, Pa. A picture of the valve is shown, printed in black and bronze, so that the special features of the valve are very graphically shown. The descriptive matter is right to the point.

The American Valve Co., Coxsackie, N. Y., is distributing an advance booklet devoted to its valves and other specialties. The booklet is neatly printed and bound as a regular catalogue. It comprises 27 pages, and contains many illustrations of the different valves this company manufactures, together with tables of sizes, capacities, prices, etc., and the many illustrations add much to its value. Copies can be had upon application to the company. Users of valves will be particularly interested in the special features of the gate valve which this company manufactures.

The Renold high-speed, silent-driving chain is a new specialty which the Link-Belt Engineering Co., Nicetown, Philadelphia, Pa., is now putting on the market. The company is distributing a catalogue which tellls in a very graphic manner the special features of this chain. There are many illustrations showing the construction of the chain and applications of it.

Those of our readers who understand French will probably be able to secure from the Standard Pneumatic Tool Co., Aurora, Ill., a catalogue which this company has just issued regarding its "Little Giant" tools and appliances, which is written in French. It is a very neatly printed catalogue, and gives innumerable illustrations of pneumatic tools and other apparatus.

Automobile Appliances is the title of the latest catalogue issued by the Mason Regulator Co., 158 Summer street, Boston, Mass. It is neatly bound in gray paper cover. There are about 40 pages, and, like all of the publications of this company, it is well designed and well executed. There are many illustrations of different accessories which this company manufactures, and complete pictures of the "Mason" automobile engine.

A Modern Method of Steam Making is the title of a pocket-size catalogue issued by F. J. Gast, 26 Cortlandt street, New York, describing Gast's asbestos air-cell coverings. The catalogue comprises 24 pages, giving a thorough description of the various asbestos coverings which Mr. Gast manufactures. A number of illustrations show the manner in which the covering is applied to steam pipes and for other purposes. There are also several pages of testimonials, together with tables of prices, etc.

The marine gas engines of the Wolverine Motor Works, Grand Rapids, Mich., have a neatly printed catalogue of 32 pages devoted to them. The catalogue is 6 by 9 inches in size, neatly bound in embossed cover. The body of the catalogue is printed in two colors and contains, besides full-page illustrations, many pictures of individual parts of the engine. Very few gas engine catalogues describe in as much detail as here given the design and construction of engines. The pictures include engines from single cylinder one-horse power to three cylinder 18-horse power.

The gauges of all kinds, thermometers, marine clocks, engine counters, air cocks, pop safety valves and other specialties manufactured by the Standard Gauge Manufacturing Co., Syracuse, N. Y., are thoroughly illustrated and described in an exceptionally complete catalogue which the company is now distributing. The catalogue is about 6 by 10 inches in size, neatly bound in dark green cover, embossed and printed in silver, and comprises 90 pages, including a complete index. Each specialty is illustrated with an excellent wood cut, and accompanying it are tables of sizes, prices, etc. The catalogue is one that should be in the hands of every ship and engine building concern, as well as every engineer.

Walworth Mfg. Co., 130-136 Federal St. BOSTON

Specialty of BRASS VALVES and Fittings for Marine Construction

Extra Heavy Valves, Bent Pipe and Fittings for High Pressure Work

Sole Manufacturers of

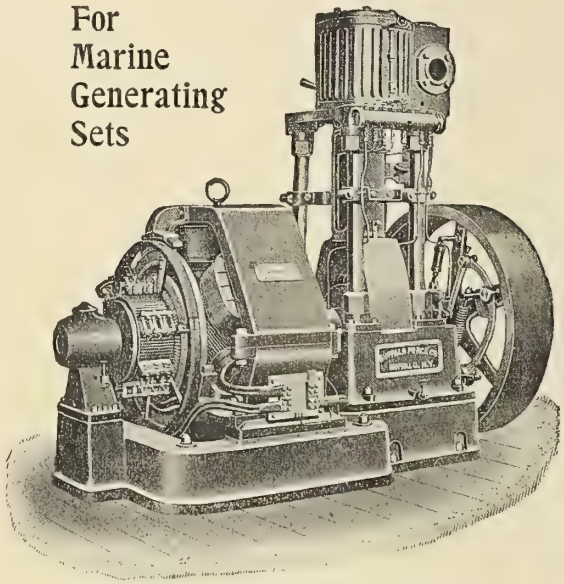
Van Stone Pipe Joint

Which does not Weep under heavy pressure

Send for Catalogue N. Y. Office: Park Row Building Prices and Terms on Application

Buffalo Marine Engines

For Marine Generating Sets



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BUFFALO, N. Y.

NEW YORK OFFICE, 39 Cortlandt Street

FRESH SNOW

Makes most white paints look anything but white. The only white paint that will bear comparison with the dazzling whiteness of new fallen snow is pure

ZINC WHITE.

Read our Practical Pamphlets:—

"PAINTS IN ARCHITECTURE."
"THE PAINT QUESTION."

Free to Any Address.

New Jersey Zinc Co.,
11 Broadway,
New York.

"The Submarine Sun" is the manner in which the Naval Electric Co., 95 Liberty street, New York, refers to the Yale submarine electric lamp in a six-page folder which is now being distributed. A picture of the lamp is given, and also much information regarding its use for submarine work. There is also a letter from the Russian naval attache referring to tests which were made of it.

The Oscar Barnett Foundry Co., Newark, N. J., is now distributing catalogue G, which is combined catalogue and price list of this company's specialties. The catalogue is a very neat one, printed in two colors, and gives a great deal of information regarding brass molders, flasks and foundry equipment. There are many illustrations, and altogether the catalogue is one which would be very valuable for reference for any one connected with foundry work.

The stocks and dies, round adjustable die plates, taps, dies and threading tools manufactured by Holroyd and Co., Waterford, N. Y., will be found fully described and illustrated in the catalogue which this company issues. The catalogue is about 6 by 9 inches in size, and comprises 48 pages with index. There are many illustrations, together with tables of sizes, prices and such other information as the user of any of these specialties would want to know. The catalogue is a most excellent one for purposes of reference.

The Eddy Valve Co., Waterford, N. Y., issues one of the finest valve catalogues we have ever seen. It is about 6 by 9 inches in size, is bound in heavy board cover and comprises 256 pages. It is devoted exclusively to the many specialties of this company, which include the Eddy taper seat and the Eddy parallel seat valves, check valves and many other types. The catalogue contains a very complete index, covering many pages, and is very thoroughly illustrated. The completeness of the book probably prohibits general distribution, but to any one who has use for a reference book on the subject of valves a copy will be of great value.

A large mailing card is being distributed by the Globe Iron Works Co., 2428 University avenue, S. E., Minneapolis, Minn., upon which are pictures of four types of gas engines manufactured by this company, and of a thirty-foot launch, together with brief descriptive matter.

Users of marine glasses should send for a copy of the booklet issued by the Warner and Swasey Co., Cleveland, Ohio. They will find much information regarding the new prism glasses, and they will be surprised at the value of these glasses for use in studying the stars at night. It is also particularly interesting to learn the manner in which the prism glasses are constructed and why they are so much more powerful than the former style of marine glasses.

Marine gasolene engines and power launches, manufactured by Smalley Brothers and Co., Bay City, Mich., will be found nicely illustrated and described in a neat catalogue which this company is distributing. The cover is of heavy paper, upon which is embossed a picture of this company's engine. A number of illustrations are shown of the engine, so that its design can be fully comprehended, and sectional views explain the manner of its construction and operation. The igniter which this company employs is also fully described. Any one interested in gas engines will find this catalogue well worth possessing.

The Newhall Ship Chandlery Co., 78 South street, New York, is sending out a mailing card descriptive of the shackles which it manufactures. This card announces that the company manufactures anchor shackles with screw from a diameter of a quarter of an inch to a diameter of an inch and a quarter, and chain shackles with screw of the same sizes. These shackles are also made with pins, if preferred. The prices are given on the mailing card, both for galvanized shackles and for black iron. The claim is made that in quality and finish these shackles are equal to the best, and that the prices are as low as the lowest.

Electric Locomotives for manufacturing establishments is the title of pamphlet No. 0-113, now ready for distribution by the C. W. Hunt Co., West New Brighton, Staten Island, N. Y. It is a 12-page pamphlet, and contains a number of illustrations of different types of electric locomotives, and gives much descriptive matter, such as the user of one of these locomotives would seek.

Tool racks, lathe pans, shelving and other machine shop furniture manufactured by the New Britain Machine Co., New Britain, Conn., are described in a 20-page catalogue now ready for distribution. The catalogue is well-printed, and, as each of the devices referred to is neatly illustrated, the catalogue is one which should interest a great many of our readers, especially those connected with shop work.

The Howard hydro-carbon motors, manufactured by the Grant-Ferris Co., Green Island, Troy, N. Y., are described in a very neatly printed and well-arranged catalogue. The catalogue is bound in heavy paper cover, richly illuminated, and the text is in two colors. There are many neat illustrations and much information regarding this engine, both two-cycle and four-cycle. Any one interested in the subject of gas engines for launches, automobiles or other stationary work will find a copy of this well worth careful study.

Drafting Room Furniture is the title to a catalogue being distributed by the J. G. Alexander Manufacturing Co., Grand Rapids, Mich. The catalogue shows that this company manufactures different styles of drafting tables, folding drawing tables and other such specialties. As these are of particular interest for use in drafting rooms and ship and engine shops, and elsewhere, the catalogue will interest a great many of our readers. We understand that copies can be had gratis by referring to MARINE ENGINEERING.

Star foot and power lathes and other specialties made by the Seneca Falls Manufacturing Co., Seneca Falls, N. Y., are described in a recently issued catalogue 18-B. The catalogue is neatly printed, with cover in two colors, and the various tools are illustrated and described to good advantage. These include lathes such as would be used in small shops and in repair shops on board vessels, also lathes of larger sizes with various accessories. Copies can be had by referring to MARINE ENGINEERING.

Stevenson's sea guide and yachting manual for 1902 is now ready for sale by Gardner and Cox, 1 Broadway, New York. It is a pocket size, cloth-bound book of 168 pages, and contains a great deal of information regarding sea and yachting matters, such as every yachtsman and other seafaring men would want to know. To go into the full table of contents would occupy a great deal of space, but the preface states concisely the purpose of the book, namely, that of placing before those who are fond of the water a compendium of information, such as tide tables, directions for entering harbors, statistics of the deep sea, as well as of the heavenly bodies by whose aid vessels are steered. The price of the book is given as 25 cents.

For Steam Making Refrigerating Apparatus
MECHANICAL THERMOMETERS
HOHMANN & MAURER MFG. CO.
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ROCHESTER, N.Y.
Write for Illustrated Catalogue M.
NEW YORK 85 Chambers Street
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LONDON 57D Hatton Garden

The hydraulic steering gear and duplex steam pumps manufactured by the Queen City Engineering Co., Buffalo, N. Y., are illustrated and described in a catalogue which this company is now distributing. A number of illustrations show graphically the construction of the steering engine. This company also manufactures other lines of specialties, including boiler feed pumps and other types of pumps. These are also illustrated and well described.

The steam hammers manufactured by the David Bell Engineering Works, Buffalo, N. Y., have a neat catalogue devoted to them which is now being distributed. These hammers, as stated in the catalogue, are designed especially for use in boiler shops, engine shops, together with other places where hammers are called for. A number of illustrations are given, showing hammers of different sizes and styles, and there is a long list of users of the hammers, together with letters from many users.

Perfection in Electric Lighting is the title to a catalogue now being distributed by Enberg's Electrical and Mechanical Works, St. Joseph, Mich. The catalogue is 6 by 9 inches in size, bound in a light green cover, neatly printed in a darker shade. The electric lighting sets which this company manufactures are shown from several points of view, so that the design of the set can be fully understood. The special features of both the engine and the dynamo are concisely described. Brief reference is also made to the electric search-light which this company manufactures.

MODERN WIRING
Our Flexible Steel Armored Conductors are endorsed by engineers for use in Marine or Ship Wiring, because of the high grade insulation, thorough protection from mechanical and other injuries, entire flexibility and low cost.
Send for descriptive bulletin No. 40115.
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General Offices: 527-531 West 34th Street, New York.
BRANCH OFFICES: CHICAGO: Fisher Bldg. ST. LOUIS: Security Bldg. BOSTON: 275 Devonshire Street. BALTIMORE: Maryland Trust Bldg.

Cadman's aluminum babbitt metal is illustrated in color on a small desk blotter which is being distributed by the A. W. Cadman Manufacturing Co., Pittsburg, Pa.

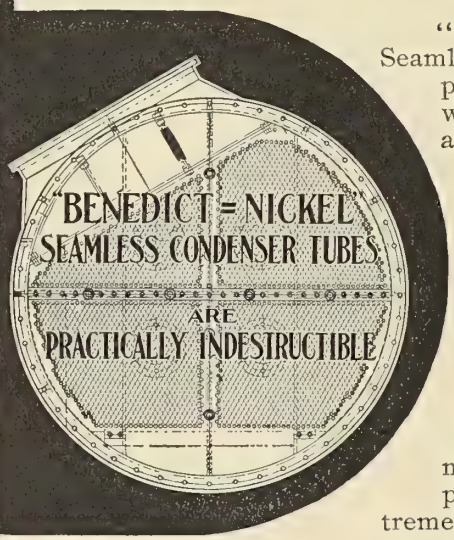
Chain Machinery is the title to the latest catalogue issued by the Turner, Vaughn and Taylor Co., Cuyahoga Falls, Ohio. It is neatly printed, and contains illustrations of this company's chain hammer and other tools, with descriptive matter, giving much information regarding machinery for manufacturing chains of various sizes.

Perry packings will be found fully described in the 1902 catalogue which La Favorite Rubber Manufacturing Co., Paterson, N. J., will send to all inquirers. The catalogue is a compact pocket-size and comprises 20 pages, including brief diary. Reference is made to the different kinds of packing which this company manufactures, and the necessary information regarding sizes, etc., is also given.

Stephenson steam specialties is the title to a new folder issued by the Stephenson Manufacturing Co., Albany, N. Y., describing the automatic force feed cylinder lubricators, the flue cleaners, bar belt dressing and other specialties manufactured by this company.

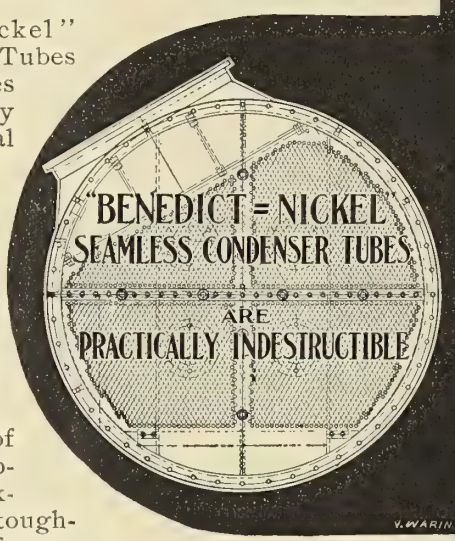
The gasolene motors manufactured by the Buffalo Gasolene Motor Co., Buffalo, N. Y., will be found fully described in the catalogue which this company will send to all inquirers. The special features of this engine are fully emphasized, and a number of illustrations are given, so that the type of the engine can be readily comprehended. Different features of the engine are described separately, so that all together one who wishes to purchase a gas engine can post himself readily from this catalogue. A number of pictures are given of launches complete, showing the manner in which the engines are installed. There is also quite a little information regarding the use of these engines for automobile purposes.

"BENEDICT-NICKEL" is peculiarly adapted for Condenser Tubes



"Benedict-Nickel" Seamless Condenser Tubes possess qualities which strongly appeal to naval authorities, large shipbuilders and consulting and designing engineers.

The inert nature of the metal (an alloy of nickel and copper) and the extreme strength and toughness of the tubes, form a combination which positively resists Electrolysis.



The life of "Benedict-Nickel" Seamless Condenser Tubes being almost indefinitely long, they are far more economical in the long run than copper or brass—these having frequently to be renewed.

"Benedict-Nickel" Seamless Condenser Tubes are spirally formed like a twist gun barrel. They are hot rolled from a solid billet,—not cast on a core.

They can be used 25 per cent. lighter than copper or brass tubes and have therefore a much greater condensing efficiency.

We can supply copper and brass seamless tubing made by the same process as "Benedict-Nickel" seamless tubes, where it is desired, as we are among the largest manufacturers of the same; but we recommend "Benedict-Nickel" on account of its longer life.

We sell **Tobin Bronze** at manufacturers' prices. This has an almost world-wide reputation for marine purposes.

Send for treatise on "Electrolysis of Condenser Tubes."

BENEDICT & BURNHAM MFG. CO.,

Mills and Main Offices, Waterbury, Conn.

New York, 253 Broadway. **Boston, 172 High Street.**

V. WARING N.Y.

The interior telephone system, manufactured by the Holtzer-Cabot Electric Co., Brookline, Mass., will be found neatly illustrated and described in a pocket-size booklet which the company is now distributing. It is a neat specimen of printing and quite a novelty as a catalogue.

Dixon's Automobile Graphites is the title to the latest publication issued by the Joseph Dixon Crucible Co., Jersey City, N. J. The title rather limits the booklet to a specific field, but, as the subject is one of lubrication, it will equally interest those who have charge of engines or machinery of any kind.

Bradley power hammers and forges, as manufactured by the Bradley Co., Syracuse, N. Y., are briefly described and well illustrated in a neat eight-page catalogue now ready for distribution. As forging is such an important feature of marine work, many of our readers will find a copy of this well worth looking over.

Some Sportsmen's Specialties is the title to a catalogue now being distributed by A. H. Funke, 101 Duane street, New York. Quite a number of rifles are shown, and they are well illustrated in the catalogue. There are other firearms of different types, also camping lamps, acetylene search-lights, acetylene cabin lamps for use on yachts, sailing vessels, etc.

The Dean boiler tube cleaner, manufactured by the William B. Pierce Co., 327 Washington street, Buffalo, N. Y., is described in a folder recently issued, which also contains the verdict of those who have tested and used this instrument. The list of testimonials embraces many of the large manufacturing and power establishments in the country, and all speak favorably of the results obtained

Calendars Received.

The E. M. Dart Manufacturing Co., Providence, R. I. This is printed in three colors, with pictures of this company's couplings and flanges. At the top is: "There is strength in our union." This saying is illustrated by a sketch of bride and groom.

C. W. Trainer Mfg. Co., 89 Pearl street, Boston, Mass., a large calendar about 24 by 30 inches in size. It is printed in three colors, with a sheet for each month, and at the top of each sheet is a picture of the steam pipe covering manufactured by this company.

ENGINEERING DATA.

There has been such a demand for engineering data in compact form that we have established a bureau for this purpose.

The plan is to supply 20 cards a month. These cards are to give information regarding new vessels, such as has appeared in the columns of MARINE ENGINEERING and in other publications; also, complete data regarding riveting, labor costs per ton dead weight in England and on our Great Lakes; data regarding boilers of different types; dimension weights and horse power per ton of various types of vessels; fuel economy on large ships per one hundred-ton miles; prices of battleships for the United States Navy per knot ton and per horse-power ton; similar data regarding cruisers and other naval vessels, etc.

This service will include 20 cards a month, or 240 cards a year. The price is as follows:—

One year	$4.00
Six months	3.00
Three months	2.00

In many instances special data can be furnished, when desired, at a slight advance in cost.

Fuller information regarding this service can be had upon application to

MARINE ENGINEERING,

309 Broadway, New York City.

The Syracuse Smelting Works, whose New York office is 94 Gold street, issue a calendar lithographed in several colors. Reference is made to the several specialties of this company, and in the center is a picture of two girls coasting on a tandem bicycle.

The Ross Valve Co., Troy, New York, sends out a handsome leather case, in which there are card calendars for each month in the year. Each card is neatly printed in two colors, and some reference to this company's business is printed inconspicuously on each one.

Wilson & Silsby, Rowe's Wharf, Boston, Mass., issue a calendar at the top of which is a handsome engraving of the yacht *Independence.* There is also given on the calendar a list of many famous yachts, the sails of which were made by this firm. The calendar contains tide tables for Boston and New York.

The Moran Towing Co., 10 South street, New York. This calendar is about 6 by 10 inches in size, and has a sheet attached for each month, upon which tide tables for Sandy Hook, Governor's Island and Hell Gate are given. At the top of the calendar is a brief reference to the business of the Moran Company.

Cousens and Pratt, 410 Atlantic avenue, Boston, Mass. This calendar has three fine engravings of sloop and schooner yachts, and a brief reference to the fact that this company's business is yacht sail-making. Attached to the center are calendar sheets, also forenoon and afternoon tides in New York harbor.

David Kahnweiler's Sons, 437 Pearl street, New York send out a calendar with a large picture at the top entitled, "A Close Call." It represents a fishing schooner which has just escaped being run down by a big ocean liner. On the back of the calendar is published information regarding all the life saving and other specialties of this firm.

The Standard Tool Co., Cleveland, Ohio. This calendar is about 6 by 10 inches in size, and is printed in three colors. There is a sheet for each month, and at the bottom of each is a brief reference to some tool manufactured by this company. Printed on the back board are tables of much value regarding machine and hand screw and pipe taps, sizes of twist drills, diameters of reamers, etc.

Thomas P. Benton and Sons, La Crosse, Wis., issues a calendar about 10 by 15 inches in size on a heavy dark gray board. In the center is a fine half-tone engraving, "The Mill Stream at Flood." At the bottom is a calendar with a sheet for each month, and at the upper left-hand corner is a brief reference to the electrical machinery, gas engines and launches which this firm manufactures.

J. Ferguson and Son, Fox Hill Foundry, 1122 Clinton street, Hoboken, N. J. On the main sheet is a striking picture in color of the interior view of the foundry, in which foxes are making castings. At the bottom is a sheet for each month, also one sheet for the entire year. Reference is made to the business of this company, which includes propeller wheels of all sizes and fine gray iron castings.

Kingsford Foundry and Machine Co., Oswego, N. Y. This calendar is handsomely printed, and is about 15 by 16 inches in size, with a sheet for each month, and on each sheet are about twelve different pictures of the various types of boilers manufactured by this company; also a picture of the new boiler plant belonging to this company. In addition to the calendar there are tide tables for Sandy Hook, Governor's Island and Hell Gate.

Charles Este, Twentieth street and Glenwood avenue, Philadelphia, Pa. This is an unusually neat and attractive calendar. The back consists of a very fine sheet of wood, scarcely heavier than ordinary paper, and it is lithographed with a picture of Mr. Este's lumber yard. There is also a brief reference to the various kinds of lumber which he handles. Attached to this wooden sheet are sheets for each month in the year, making the calendar complete for 1902.

ANNOUNCEMENT.

TO THE TRADE:

Two of the best informed and most reliable firms of **Patent Attorneys** in the **United States** make us the **following statement:**

THE "LITTLE GIANT" RECIPROCATING PISTON AIR DRILLS, NOW BEING MANUFACTURED BY THE STANDARD PNEUMATIC TOOL CO., OF CHICAGO, DO NOT INFRINGE IN ANY PARTICULAR ON ANY PATENT FOR ROTARY or OTHER DRILLS.

We hereby guarantee all purchasers and users of **"Little Giant"** Drills against all liabilities.

We will assume the defense of any litigation against our customers which may result from the sale or use of our drill, and respectfully request the trade to pay no attention to **intimidating circulars** which are sent out for the sole purpose of **attempting to injure** our business.

Yours respectfully,

Standard Pneumatic Tool Co.

General Offices and Works
AURORA, ILL.

By E. N. HURLEY, President.

BUSINESS NOTES.

AMERICAN STEAM SPECIALTIES.—The American Steam Gauge and Valve Manufacturing Co., Boston, Mass., reports the volume of business for 1901 largely in excess of that of any previous year, and with an outlook for 1902 much more promising than was last year's business. Notwithstanding that this company moved into a large, new and finely equipped factory two years ago, doubling the manufacturing facilities, large additions to the plant are already contemplated. The demand in this country for this company's gauges and valves has very greatly increased, and foreign business is crowding the company hard. Notwithstanding many other indicators on the market, this company reports a steadily increasing demand for its Thompson indicator. A handsome calendar will be ready for delivery in a few days to all friends of the company who send for one.

RISDON IRON WORKS.—The machinery in the shops of the Risdon Iron and Locomotive Works, San Francisco, Cal., described in the editorial pages this month, is supplied by the following firms: Radial countersinkers by Detrick and Harvey, hydraulic keel plate bender by the Niles-Bement-Pond Co., and the remaining tools in the punch shop by the Hilles and Jones Co. In the machine shop practically all of the heavy tools and many of the smaller engine lathes were supplied by the Niles-Bement-Pond Co. There are also Hendey-Norton lathes, Gisholt lathes, Jones and Lamson turret lathes, Gray planers, Detrick and Harvey open side planers and Pawling and Harnischfeger electric traveling cranes. In the boiler shop there are Newton circular saws, Bement-Niles and Hilles and Jones tools, Pawling and Harnischfeger electric cranes and hydraulic tools and other riveters made by the Risdon Co. The electric equipment was furnished throughout by the Westinghouse Electric and Manufacturing Co. The steel buildings were built by the American Bridge Co. and Jones and Laughlins. The air compressors, hydraulic pumps, accumulators and boilers were manufactured by the Risdon Company's shops. The apparatus furnished by the Westinghouse Company consisted of a large number of type C induction motors for 2-phase current at 7,200 alternations, three 10, seven 5, five 20, three 7 1-2, one 15, one 100, three 50, one 150, two 30 and one 1 horse power motors. Together with these motors the company furnished the necessary transformers, autostarters, controlling switches, etc. The company has also shipped to the Risdon Works a large number of small direct-current generators operating at 125 volts, which it is supposed were to be used for installation on shipboard. It has also furnished the following direct-current motors: Two 30 horse power series, 110 volt multipolar motors; one 10 horse power, 500 volts; one 20 horse power shunt motor, 220 volts; one 2 horse power series motor, 220 volts, and one 7 1-2 horse power motor, 500 volts.

SPECIAL NOTICES.

Announcements under this heading will be inserted at the uniform rate of thirty-three-and-a-third cents a line. Lines average ten words each.

MACHINISTS WANTED.

First-class all-round machinists on Marine work. Call on or address, HOLLAND TORPEDO BOAT COMPANY, New Suffolk, N. Y.

SCHOLARSHIP FOR SALE.

A complete paid up scholarship in the mechanical course of the International Correspondence School is for sale. Price $25. Address SCHOLARSHIP, care Marine Engineering.

SECOND-HAND YACHT WANTED.

A second-hand yacht about 60 feet long, 9 or 10 feet beam, to have about a 25 horse-power engine and fitted with cabin and other accommodations is wanted. Address giving full particulars of yacht with photograph,

YACHTSMAN, care of Marine Engineering.

LUMEN BRONZE.—The well-known bearing metal, lumen bronze, which is an invention of Professor Carpenter, of Cornell University, will hereafter be manufactured by the Lumen Bearing Co., Buffalo, N. Y., this company having succeeded the Bierbaum and Merrick Metal Co.

NEW MARINE REPAIR SHOP.—A new shop has been established by A. Burrows at Clinton and Fifteenth streets, Hoboken, N. J. This plant is thoroughly equipped for all kinds of blacksmithing, especially such as would be called for in marine repairs. The shops are equipped to make light and heavy forgings and attend to other branches of marine work.

THORNTON ELECTRICAL WORKS.—G. C. Thornton has found it necessary, owing to the great enlargement in his business, to incorporate under the name of the Thornton Electrical Works. The company will continue to occupy the office of the former firm at 3 East Fourteenth street, New York, and will continue on a more extensive scale than before the manufacture of electric bells for vessels, yachts and launches, together with dry batteries, miniature lamps and other electrical specialties.

HAWKINS' WORKS
for
Progressive Engineers
on
Steam and Electrical
ENGINEERING
6 VOLUMES IN SET FOR $11.
Terms $1.00 a Month.
Write today for particulars
Theo. Audel & Co. Pub.
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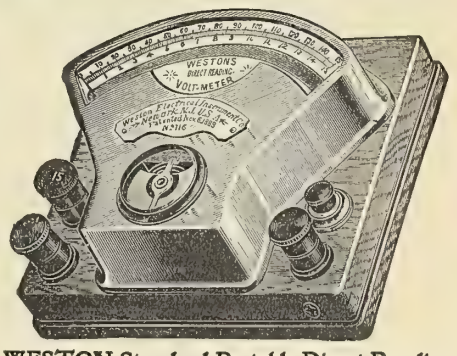
WESTON STANDARD PORTABLE
DIRECT-READING

Voltmeters, Ammeters, Millivoltmeters, Voltammeters, Milliammeters, Ohmmeters, Portable Galvanometers, Ground Detectors and Circuit Testers.

Our Portable Instruments are recognized as **the standard** the world over. Our **Voltmeters** and **Ammeters** are unsurpassed in point of extreme accuracy and lowest consumption of energy.

WESTON ELECTRICAL INSTRUMENT CO.,
Waverly Park, Essex County, N. J., U. S. A.

BERLIN:—European Western Electrical Instrument Co., Ritterstrasse 88.
LONDON:—Elliott Bros., 101 St. Martin's Lane.



WESTON Standard Portable Direct Reading Voltmeter.

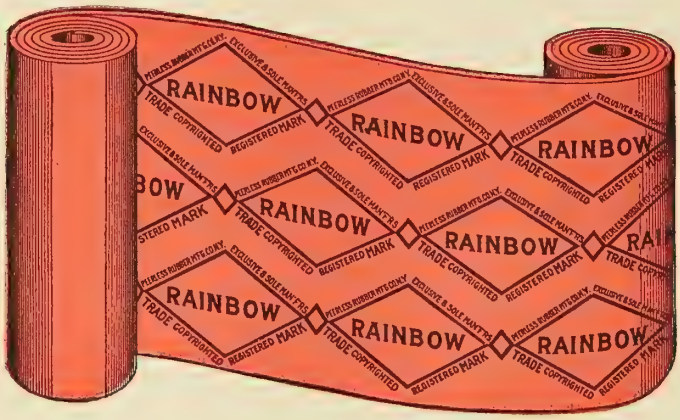
Rainbow Packing

Makes Steam, Flange and Hot Water Joints Instantly

Thousands of Imitators.

No Equal.

Will Hold Highest Pressure.



Don't have to Use Wire and Cloth to Hold

RAINBOW

Can't Blow it Out.

THE COLOR OF RAINBOW PACKING IS RED

See that the Trade Mark (three rows of diamonds in black, connected) extends throughout the entire length of each yard or roll

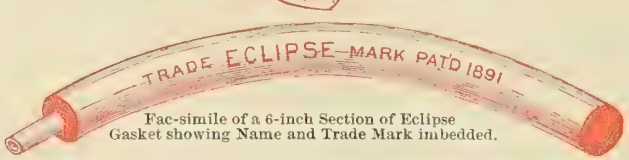
WILL CARRY IN STOCK

It is an undisputed fact that Rainbow Packing is the only Sheet or Flange Packing in the world that will carry in stock for months and years without hardening or cracking

THE ECLIPSE SECTIONAL RAINBOW GASKET

⅜ in.
½ in.
⅝ in.
} **For Hand Holes.**

¾ in.
⅞ in.
1 in.
} **For Extra Large Joints.**



Fac-simile of a 6-inch Section of Eclipse Gasket showing Name and Trade Mark imbedded.

The Eclipse Gasket is red in color, and composed of the celebrated Rainbow Packing Compound. It will not harden under any degree of heat, or blow out under the highest pressure, and can be taken out and repeatedly replaced. Joints can be made in from three to five minutes.

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NEPTUNE
Anti-Fouling Compound

FOR

Marine Boilers

SEE WHAT ONE OF THE LARGEST STEAMSHIP COMPANIES SAYS ABOUT IT

ENGEL & FAGERSTEN CHEMICAL CO.

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Agents wanted in foreign countries.

The Engel & Fagersten Chemical Company,

MANUFACTURERS OF THE NEPTUNE ANTI FOULING COMPOUND FOR BOILERS USING OCEAN OR SWEET WATERS.

NEW TWIN-SCREW EXPRESS STEAMSHIP KAISER WILHELM DER GROSSE

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BOWLING GREEN OFFICES 5 BROADWAY

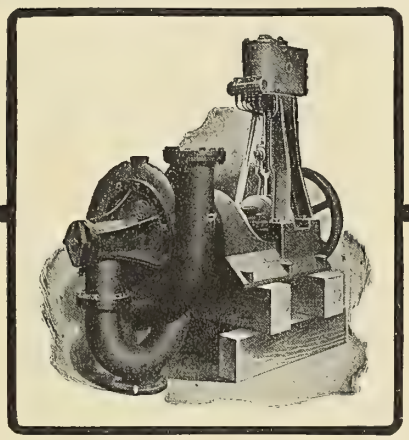
New York May 14/1901. 190

Engel & Fagersten Chemical Co.,
#1702 Wabash Ave.,
Gentlemen: Chicago, Ills.

"In reply to your valued favor of April 12th, would say that since July, 1900 we have gradually used on 17 different steamers the Anti-fouling Compound for boilers with satisfactory results, and that we intend to introduce this Compound on all of our steamers, for which purpose, as you are aware, we have but recently again ordered 5000 kilograms."

Yours very truly,

Oelrichs & Co



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Marine Boilers

INTERNALLY FIRED TYPES.

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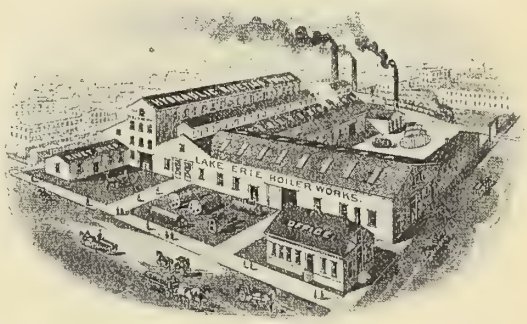

THE BEST EQUIPPED PLANT IN AMERICA FOR THE MANUFACTURE OF MODERN MARINE BOILERS.

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THE NEW JERSEY ASBESTOS COMPANY

Original and only manufacturers of the far-famed

"GLADIATOR"

Asbesto-Metallic Sheet Packings, Valve-Stem and Piston Rod Packings and Gaskets.

The only Packings and Gaskets which have given, and continue to give, uniform satisfaction throughout. Will resist the highest steam pressure, and the Sheeting and Gaskets can be used over and over again without impairing their efficiency.

N. B.—All goods of the same character on the market are imitations, and, almost invariably, are of foreign manufacture.

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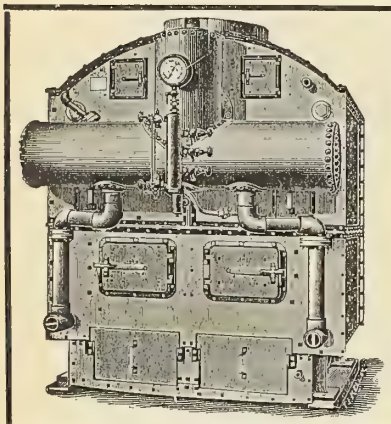

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130 Steam Yachts, ... 1 to 5 Boilers Each.

60 Passenger Steamers, Tugs and Lighters, ... 1 to 6 Boilers Each.

15 Vessels in the Government Service.

40 Steam Launches. 75 Stationary Plants.

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For Marine and Other Uses

THE NATIONAL TUBE CO.

The Largest Manufacturer in the World of Wrought Iron and Steel Tubular Goods, is now prepared to accept orders in any quantity and for any size of

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" 95, A. P. Jerguson, Box 198, Key West, Fla.
" 100, Jas. P. Lynch, Honolulu, H. I.
" 101, Thos. J. Hanlon, Box 765, Norfolk, Va.
" 102, Fred W. Linsemeyer, 210 Clinton St., So. Haven, Mich.
" 103, C. H. Hall, Box 512, New Berne, N. C.
" 104, J. H. Blumer, Moss Point, Miss.

TRADE PUBLICATIONS.

Standard tables of valves, fittings, and flanges are being distributed by the Best Manufacturing Company, Pittsburg, Pa. These tables are published in booklet form and will be found exceedingly useful by those who have anything to do with steam.

A Pocket Diary and Note Book will be sent to all readers of MARINE ENGINEERING who apply to the David B. Crockett Company, Bridgeport, Conn. This book is of convenient size for the vest pocket and contains in addition to this diary, much information regarding holidays, postage, interest laws, revenue regulations, etc.

Engineers' special tools are described in a booklet under the head of "Engineers' Chums," copies of which can be had upon application to the Mound Tool and Scraper Company, 710 Howard street, St. Louis, Mo. It refers to the sets of scraping tools, cold chisels, packing tools and other specialties which this company manufactures.

Coal Handling Machinery is the title to a catalogue now being distributed by the C. W. Hunt Company, West New Brighton, Staten Island, N. Y. It comprises 32 pages and contains much information of value to our readers. It is well illustrated, having many half-tone engravings and a number of sectional drawings, showing fully the several specialties which this company manufactures.

Marine Hardware of all descriptions, launch fittings, gas engine parts, automobile fittings and special castings of many other knids, as manufactured by the Norwalk Brass Company, Norwalk, Conn., will be found described and illustrated in the 1902 catalogue which is now being distributed, copies of which can be had upon application. The catalogue is about 6 by 9 inches in size, comprises 32 pages and is well printed and illustrated.

Marine Engines and Boilers, steamboat machinery steam yachts, and launches manufactured by Chas. P. Willard and Company, 47 South Canal street, Chicago, Ill., will be found fully described and illustrated in a catalogue now beng distributed. This catalogue contains many pictures of full page size of engines and boilers, together with many pictures of launches. Considerable attention is given to stern wheel boats and especially to their mechanical equipment.

The motors and launches manufactured by the Church Motor and Launch Company, 62 William street, New York, will be found described in an excellent manner in a booklet which is now ready for distribution. This company's engine is fully described and much information given regarding it. There is also a great deal of information regarding the various types of hulls which this company builds. Every reader interested in launches should have a copy.

The Wheeler condensers, feed water heaters, centrifugal pumps, evaporators, combined air and circulating pumps, and other specialties will be found very fully described in a catalogue of 120 pages, a copy of which can be had upon application to the Wheeler Condenser and Engineering Company, 120 Liberty street, New York. The catalogue is 6 by 9 inches in size, fully illustrated, and as it is neatly bound and published it will be found of much value for reference by those of our readers interested in the subject.

The hand book of the American School of Correspondence, Boston, Mass., for 1902, has just been published and is now ready for distribution. It is neatly printed in two colors and gives in much detail a complete story of this school and the many courses. A great deal of information is given regarding each course showing what subjects are covered and the thoroughness with which they are covered, also samples of examination papers and much other information of value to those students who contemplate taking a course of correspondence instruction.

Steam Separators, Oil Extractors, and other specialties manufactured by the Keystone Engine and Machine Company, Fifth and Buttonwood streets, Philadelphia, Pa., have a bulletin of 16 pages devoted to them, which is now being distributed, copies of which can be had on application.

Centrifugal Pumping Machinery is the title to a very complete catalogue, 6 by 9 inches in size, just being distributed by R. D. Wood and Company, Philadelphia, Pa. It contains 100 pages and many illustrations, covering with much thoroughness the entire field of centrifugal pumps.

A compact engine suitable for running launches, pumps, fans, hoists, and other apparatus where light power is wanted, will be found described in a folder being distributed by J. E. Wise, Machinery Department, The Bourse, Philadelphia, Pa., describing the Leonard High Speed Multi-cylinder Engine.

Submarine Torpedo Boats is the title to a handsomely published catalogue being distributed by the Lake Torpedo Boat Company, 11 Broadway, N. Y. It is handsomely printed and contains a number of illustrations of the Lake submarine torpedo boat, showing its design and construction and explaining the manner in which it is intended to work.

Thermometers for Cold Storage, Refrigeration, and Ice Manufacture is the title of a catalogue now being distributed by the Hohmann and Maurer Manufacturing Company, Rochester, N. Y. It is handsomely printed and fully illustrated with thermometers in great variety. Any of our readers at all interested in the subject will find the catalogue of much value.

The heavy lathes manufactured by the Pond Machine Tool Company, 136 Liberty street, New York, have a handsome catalogue devoted to them. It is 9 by 12 inches in size, printed in two colors on heavy coated paper. The illustrations are a full page in size and the printing is of the very best. Any one interested in the subject of engineering tools will find a copy of this catalogue of much value.

The Foster pressure regulator and other high grade specialties will be found fully illustrated and described in a catalogue which is being distributed by the Foster Engineering Company, 107 Monroe street, Newark, N. J. The catalogue is 6 by 9 inches in size and comprises nearly 100 pages. It is neatly bound and is printed on heavy coated paper. A copy ought to be in the hands of every engineer.

The Electric Supplies of the Western Electric Company, New York, have a very complete catalogue devoted to them which has just been published. It is a volume of 5 by 7 inches in size and 2 inches thick. It contains nearly 1,100 pages and there are nearly 3,000 illustrations. It apparently contains everything which one could possibly want to find out about in connection with electrical supplies for ship goods, for lighting and power purposes or any other electrical purpose. Because of the great expense of the catalogue we understand that the charge of one dollar is made for copies of it.

FIRST

In Quality

In Every-thing

UP-TO-DATE

Send for Free Catalogue No. 16-L.

THE L. S. STARRETT COMPANY
Athol, Mass., U. S. A.

Fuel for Boilers is the title of catalogue B now being distributed by the Rockwell Engineering Company, 26 Cortlandt street, New York. It is 8 by 10 inches in size, well illustrated, and as it is devoted to a subject in which there is a great deal of interest it will be found of much value to our readers. The fuel oil burning system of this company is fully shown. Copies can be had by referring to Marine Engineering.

Ship's Deck Pumps,
Bilge Pumps,
Triplex Power Pumps.

We make
HAND AND
POWER PUMPS
for all purposes.
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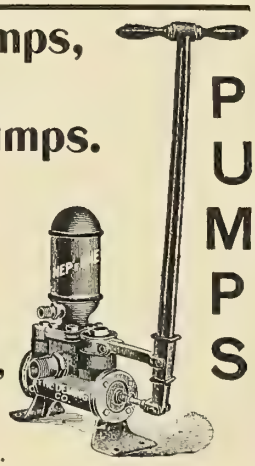

PUMPS

The Deming Company,
SALEM, OHIO.

HENION & HUBBELL,
Gen'l Western Agts., CHICAGO, ILL.

For Steam Making Refrigerating Apparatus

MECHANICAL THERMOMETERS

HOHMANN & MAURER MFG. CO.
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For All Engineering and Manufacturing Purposes

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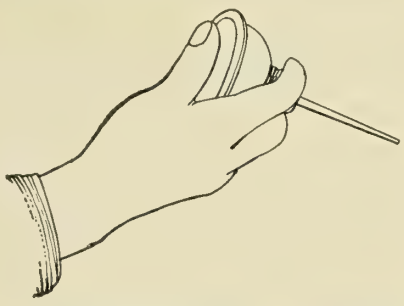


The Nicest Thing

You can use is

DIXON'S

Pure Flake

GRAPHITE

in an ordinary

SQUIRT CAN.

For valves and cylinders and all bearings there is nothing to equal Dixon's graphite. Sample free.

JOSEPH DIXON CRUCIBLE CO., JERSEY CITY, N. J.

The exhaust heads manufactured by the B. F. Sturtevant Company, Jamaica Plain, Mass., are attractively and concisely described in a private mailing card issued by the company, copies of which can be had on application.

Theo. Audel and Co., 63 Fifth avenue, New York, are sending out to all inquirers a booklet giving a great deal of information regarding the Hawkins educational works for engineers, firemen, electricians, machinists and others.

Students who seek engineering instruction by correspondence will find much to interest them in a catalogue issued by the International Correspondence Schools, Washington, D. C. The book is very complete, being about 50 pages in size.

Calendars Received.

James L. Robertson and Son, 108 Fulton street, New York, are distributing a calendar, 7 by 13 inches in size, with a sheet for each month, at the top is a picture of a girl in bathing costume.

The Fort Wayne Electric Works, Fort Wayne, Ind., send out a calendar each month neatly engraved, being one of the popular designs modeled in clay. On each issue is a picture of some one type of machine manufactured by this company.

The Falls Hollow Staybolt Company, Cuyahoga Falls, Ohio, sends us a calendar, 10 by 16 inches in size, containing a large lithograph, in colors, of a famous painting representing three men shaking dice, raffling for a bird. At the bottom of the card is a calendar with a different sheet for each month.

The American Steam Gauge and Valve Manufacturing Company, Boston, Mass., is sending out a handsome calendar, at the top of which is a fine engraving, having at the left a picture of a battleship and at the right a picture of a modern compound locomotive. There are also pictures of gauges, indicators, etc. The calendar is about 12 by 18 inches in size.

The Whiting Foundry Equipment Company, Harvey, Ill., is distributing a calendar nearly a yard square. At the bottom is a sheet for each month and in the center is a large map of the world in color. Surrounding it are pictures of overhead jib and other cranes which this company manufactures; also different specialties in the line of foundry equipment.

Alfred B. Sands and Son, 134 Beekman street, New York, send a calendar, 8 by 10 inches in size, with a sheet for each month and a very attractive picture of the yacht *Defender*. The Messrs. Sands also send us another calendar with a picture at the top representing a bark rounding Cape Horn in a gale. This calendar contains tide tables for both Boston and New York.

The J. S. Hoskin's Lumber Company, Marine Bank building, Baltimore, Md., sends a calendar with a handsome color lithograph at the top, entitled "Solid Comfort," representing an old musician who has laid his 'cello one side to enjoy a comfortable smoke. Below reference is made to the ship spars, ship timber, tree nails, decking, knees and other specialties which this company handles.

BUSINESS NOTES.

POST DRILLS—The Cleveland Punch and Shear Works Co., Cleveland, Ohio, finds a steady demand for its lever and screw fitted post drills. The lever feeding machine that is specially adapted for drilling and countersinking holes in large plates, beams, etc., is found to be of great use in shipbuilding. A screw feed machine is specially adapted for cutting flue holes in boiler plate and other heavy drilling, and is an excellent tool in boiler and machine shops.

Walworth Mfg. Co., 130-136 Federal St. BOSTON

Specialty of **BRASS VALVES** and Fittings for Marine Construction

Extra Heavy Valves, Bent Pipe and Fittings for High Pressure Work

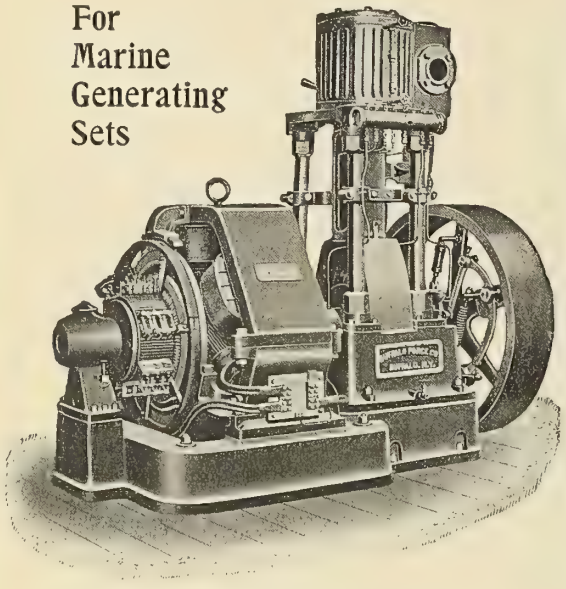
Sole Manufacturers of **Van Stone Pipe Joint**

Which does not Weep under heavy pressure

Send for Catalogue N. Y. Office: Park Row Building Prices and Terms on Application

Buffalo Marine Engines

For Marine Generating Sets



Buffalo Forge Company,

BUFFALO, N. Y.

NEW YORK OFFICE, 39 Cortlandt Street

The Conditions

requisite for the most beautiful and most durable painting are a dry surface, dry weather, pure oil, a preponderance of

ZincWhite

and plenty of time for drying between coats.

Read our practical pamphlets:

"Paints in Architecture,"
"The Paint Question."

Free to any address.

THE NEW JERSEY ZINC CO.
11 BROADWAY, NEW YORK

Sprague Orders.—The Sprague Electric Company, 527 West Thirty-fourth street, New York, has closed an order with the Atlas Portland Cement Company for three 400 kilowatt engine type split pole generators at speed of 156 revolutions per minute, for its plant in Hannibal, Mo.; another order is from the De Laval Steam Turbine Company, for ten 20 kilowatt and ten 75 kilowatt turbine generators. The Pennsylvania Steel Company has ordered for its new bridge shop at Steelton, Pa., fifteen wall crane trolley hoists, the electric hoisting equipment of which is built by the Sprague Company.

Marine Supplies.—The Eagle Oil and Supply Company, 104 Broad street, Boston, Mass., wishes to thank the many captains and engineers for the past favors during the yachting season, and to state that the business of this company for the last year has been the largest and most successful in the history of the house. The coming season will find this company better equipped than ever to handle the demands of the marine buyers, and prompt delivery is promised in all cases. Engineers and captains are invited to call and look over probably the large stock before purchasing (all under one roof) in Boston which caters to the requirements of the marine purchaser in deck and engine room supplies.

Interesting Boiler Test.—The Stirling Company, Pullman building, Chicago, Ill., has just received from its correspondents, in France, information regarding a series of boiler trials conducted under the direction of the Boiler Committee of the British Admiralty in three sloops of exactly the same construction, tonnage, etc., and similar in all respects except that each has water tube boilers of a different type. The results with the *Fantome* which had Niclausse boilers, on a trial of thirty hours at 300 horse-power, was a consumption per horse-power per hour of 1.71 pounds. At 1,000 horse-power 1.54 and at full horse-power of 1,400 a consumption of 1.54. The French Government has just placed an order for Niclausse boilers for cruiser *Jean Bart*.

Boiler Staybolts.—We are informed by the Falls Hollow Staybolt Company, Cuyahoga Falls, O., that its business has been steadily increasing during several years past and that it receives no complaints of any description regarding its products. This company guarantees every bar of staybolt material, whether iron or steel, to meet the Government specifications and inspection.

Baltimore Dry Dock Company.—The Baltimore Dry Dock Company, Baltimore, Md., recently succeeded to the business and plant formerly managed by the Columbian Iron Works and Dry Dock Company. The new Company has started out with ample capital and has added a large amount of new machinery bringing the plant up-to-date in its equipment. A part of the plant consists of a 470 foot dry dock, so that the new company is in position to build new vessels or to repair those already built, at prices and on time limits equal to other companies. Because of the great extension of the company's business, the name has recently been changed, so that the company is now known as the Baltimore Shipbuilding and Dry Dock Company.

Condensing Apparatus.—The contract for the condensing apparatus for the Rapid Transit power station, New York, has been awarded to the Alberger Condenser Company, 95 Liberty street, New York. This is believed to be the largest contract ever given for a condensing apparatus, the total capacity of the outfit being 80,000 horse-power, comprised of eight units of 10,000 horse-power each. The type selected by the engineers of the Rapid Transit Subway Construction Company is the Barometric Condenser recently brought out by the Alberger Company. This is a jet Condenser and operates on the dry vacuum system. The water, circulating and air pumps are to be operated by cross compound steam cylinders with cranks and flywheels. The whole equipment is new and original in design and is expected to give unusual results, both in economy and from an operative point of view.

Fusible Plugs.—At this time general interest is being taken in the subject of fusible boiler plugs, owing to several recent boiler explosions both on land and at sea. Many fusible plugs on the market have been found that the metal of which they are made, or owing to the form of the plug, will not fuse at the temperature stated. The Van Wagenen Ship Chandlery Co., 233 West street, New York, made an affidavit that on and after November 21, 1901, all fusible plugs made by this firm will be filled with good Banca tin, stamped with the sole licensee's name, George Van Wagenen, and that the plugs will be made in strict accordance with sections 26, Rule 11, Rules and Regulations of the Board of Supervising Inspectors, and also in compliance with Department Circular No. 98, dated at Washington, D. C., November 8, 1901. This company manufactures the Bailey patent fusible plug for marine boilers, which are recommended by the United States Board of Supervisors of Steam Vessels, by Prof. R. H. Thurston and other practical authorities.

THE
McKim Gasket

Cannot Blow Out.

Can be re-applied indefinitely.

Made of packing encased in soft rolled metal, combining the elasticity of one with the strength of the other. All sizes of manhole and hand-hole plates and pipe fittings.

McCORD & CO.
104 Broadway - - - - New York
1471 Old Colony Building - - Chicago

Anchors for the Emperor's Yacht.—It is announced that order has been placed with the Cape Ann Anchor Works, Gloucester, Mass., for one anchor weighing 900 pounds and another weighing 1,000 pounds for the yacht *Meteor* which the Townsend and Downey Shipbuilding Company, New York, is building for the German Emperor. Each anchor is to be filed all over to be made smooth and then is to be galvanized.

Palmer Launches.—Palmer Bros., Cos Cob, Conn., have been awarded contracts for two boats for the Cheesebrough Bros., of Brooklyn, N. Y., for pleasure purposes. The contract calls for one 35 foot speed launch 6 feet 6 inches beam, to be equipped with a 12 horse-power motor of the 4-cycle type; the other launch is to be 38 feet long, 8 feet beam, and is to be a cabin cruising launch, finished in mahogany and to have all the latest comforts and conveniences.

Little Giant Pneumatic Tools.—Owing to the increase in its Canadian business, the Standard Pneumatic Tool Company, Aurora, Ill., has appointed J. B. Wilson manager of new Canadian offices which have just been opened at 103 Union Station Arcade, Toronto, Ontario. The company will carry at this office a full line of Little Giant pneumatic tools and appliances, repair parts and accessories. The office will be made an important one so that hereafter all orders for Canadian customers can be supplied promptly from Toronto.

Havana Dry Dock.—The Havana Dry Dock Co. demonstrated its ability to handle large ships with dispatch by recently docking the P. & O. steamer, *Miami*. This vessel was thoroughly scraped and painted and some intricate repairs made to her machinery, and the day on which she was discharged another steamer took her place on the dock. This floating dock has been but recently completed, and is now open for general operation. A table of prices for docking vessels of various sizes may be obtained by addressing this company, either at their New York address, 32-34 Broadway, or at Havana, Cuba.

Free Sample of Packing.—The Boston Belting Company, 256 Devonshire street, Boston, Mass., is meeting with great success in one of its latest products, Forsyth Combination Packing. This packing is made of rubber with one or more plies of flexible sheet metal insertion. It is claimed to retain its life and elasticity and to be more durable than cloth insertion packing. There is a strong adhesion between the metal and the rubber. The packing is very flexible and is not so liable to blow out as ordinary packing. An important claim for this product is that it will satisfactorily withstand the heat of high pressure steam and that it is practically a metal packing with elastic surfaces. Samples of the packing will be sent to readers of Marine Engineering who write for them. The packing is made in sheets 36 inches wide and not exceeding ten yards in length. It is made in different thicknesses from a sixteenth of an inch up.

MODERN WIRING

Our Flexible Steel Armored Conductors are endorsed by engineers for use in Marine or Ship Wiring, because of the high grade insulation, thorough protection from mechanical and other injuries, entire flexibility and low cost.

Send for descriptive bulletin No. 40115. Send for catalogue 40,415.

SPRAGUE ELECTRIC COMPANY

General Offices: 527-531 West 34th Street, New York.

BRANCH OFFICES: CHICAGO: Fisher Bldg. ST. LOUIS: Security Bldg. BOSTON: 275 Devonshire Street. BALTIMORE: Maryland Trust Bldg.

A School in Naval Architecture.—Arrangements have been made by the New York Nautical College, 130 Water street, New York, to start a department of naval architecture which will be under the charge of George Crouse Cook.

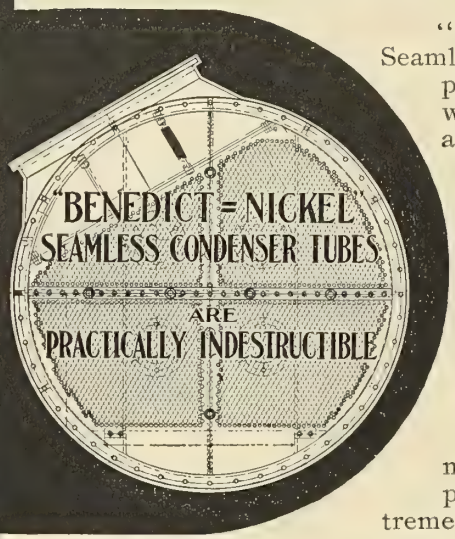
To Repack the Hohenzollern's Engines.—We are informed by the United States Metallic Packing Company, Thirteenth and Noble streets, Philadelphia, Pa., that the engines of the Emperor of Germany's yacht, *Hohenzollern*, are to be re-equipped with United States metallic packings.

Asbestolith.—Asbestolith is the name of a material which is finding very general use for fire-proof floors, sanitary work, etc. It has been used quite a little by the United States Government, much of the flooring in the rebuilt *Cincinnati* being of this material. It is being put on the market by the Asbestolith Company, 95 Nassau street, New York, which will send samples and give full information by referring to Marine Engineering.

Photography.—A. J. Drummond, 50 Fulton street, New York, makes a specialty of photographing for industrial and other purposes. He does a large business in making photographs for Court exhibits and has special facilities for making photographs of the largest size as well as for making pictures of machinery, interior views, maps, drawings, etc.

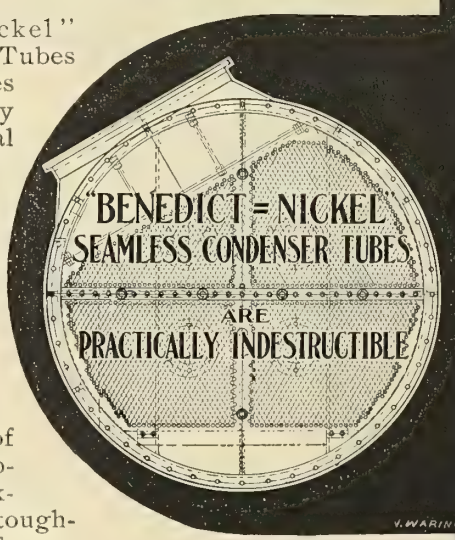
Vessels Classified.—The American Bureau of Shipping, 66-68 Beaver street, New York, has classed and rated recently, in the "Record of American and Foreign Shipping," the following vessels: American Screw *Brandon*, American Screw *El Alba*, American Sch. *Prescott Palmer*, American Sch. *James Pierce*, American Sch. *Adelaide Barbour*. American Sch. *Kenwood*, American Sch. *Gage H. Phillips*, American Bark *Adam W. Spies*, American Bark *Virginia*, American Trn. *J. S. Hoskins*, American 3 mast Sch. *Viola Reppard*, American Bark *Willard Mudgett*, British 3 mast Sch. *Nellie Louise* and British 3 mast Sch. *W. N. Zwicker*.

"BENEDICT=NICKEL" is peculiarly adapted for Condenser Tubes



"Benedict-Nickel" Seamless Condenser Tubes possess qualities which strongly appeal to naval authorities, large shipbuilders and consulting and designing engineers.

The inert nature of the metal (an alloy of nickel and copper) and the extreme strength and toughness of the tubes, form a combination which positively resists Electrolysis.



The life of "Benedict-Nickel" Seamless Condenser Tubes being almost indefinitely long, they are far more economical in the long run than copper or brass—these having frequently to be renewed.

"Benedict-Nickel" Seamless Condenser Tubes are spirally formed like a twist gun barrel. They are hot rolled from a solid billet,—not cast on a core.

They can be used 25 per cent. lighter than copper or brass tubes and have therefore a much greater condensing efficiency.

We can supply copper and brass seamless tubing made by the same process as "Benedict-Nickel" seamless tubes, where it is desired, as we are among the largest manufacturers of the same; but we recommend "Benedict-Nickel" on account of its longer life.

We sell **Tobin Bronze** at manufacturers' prices. This has an almost world-wide reputation for marine purposes.

Send for treatise on "Electrolysis of Condenser Tubes."

BENEDICT & BURNHAM MFG. CO.,

Mills and Main Offices, Waterbury, Conn.

New York, 253 Broadway. **Boston, 172 High Street.**

V.WARING N.Y.

Remington Gas Motors.—The Remington Automobile and Motor Company, Utica, N. Y., has secured the services of H. B. Maxwell, the well-known gas engine expert, to take entire charge of its experimental and motor construction department.

Marine Upholstery.—M. W. Fogg is now fully settled in the large and completely equipped new building at 202 Front street, New York, and is in shape to fill promptly orders of any size for anything in the line of cushions, mattresses and marine upholstery.

A Busy Launch Builder.—The Davis Dry Dock Company, Kingston, Canada, has on hand orders for many launches which are to be ready for the coming season. Among them a 40-foot gasoline launch, for use in the Thousand Islands; a 34-foot launch, for use in the same waters; a 38-foot steam launch with compound engine and water tube boiler, for use in Canadian waters; a 30-foot gasoline launch, for use in local waters, together with two 40-foot steam launches and one 40-footer with triple expansion engines.

Yacht and Launch Repairing.—The Newport Engineering Works, Newport, R. I., has just built a shop 70 by 30 feet in size, two stories high, on lower Thames street. The business of this company will be the building of steam and gas engines and all sorts of repair work for launches and yachts. The shops are believed to be as finely equipped for this purpose as any other shop along the New England coast. A. Livingston Mason is at the head of the new company, and the engineering part of the work is in charge of Earl P. Mason, a recent graduate of the Massachusetts Institute of Technology. This concern has been connected with yacht and steamboat work for many years. A novel feature of the establishment is a reception room for deck and engineer officers of yachts and vessels of all kinds. This room will have on file leading publications of all kinds and the establishment is on the water's edge convenient to the anchorage grounds. This place can be used as headquarters by officers and for mailing and receiving letters.

ENGINEERING DATA.

There has been such a demand for engineering data in compact form that we have established a bureau for this purpose.

The plan is to supply 20 cards a month. These cards are to give information regarding new vessels, such as has appeared in the columns of Marine Engineering and in other publications; also data regarding ship riveting, labor costs per ton dead weight in England and on our Great Lakes; data regarding boilers of different types; dimension weights and horse power per ton of various types of vessels; fuel economy on large ships per one hundred-ton miles; prices of battleships for the United States Navy per knot ton and per horse-power ton; similar data regarding cruisers and other naval vessels, design dimensions of engines, new formulæ; in fact, all current data useful to the practical designer and engineer, etc.

These cards will be of the standard library size, suitable for filing with personal data, in the standard library index boxes.

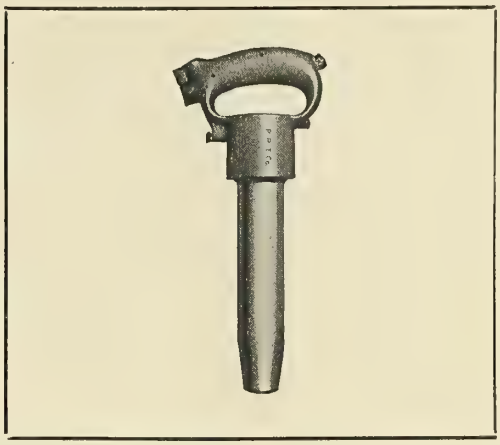
This service will include 20 cards a month, or 240 cards a year. The price is as follows:—

One year	$4.00
Six months	3.00
Three months	2.00

In many instances special data can be furnished, when desired, at a slight advance in cost.

Fuller information regarding this service can be had upon application to

MARINE ENGINEERING,
309 Broadway, New York City.



Three Points

Our pneumatic tools work fast. So do some others.
Ours keep on working. The valve parts don't wear out. Others do.
Our tools are strong. You can give them to Pat, Pedro or Black Jim without fear. With other tools — be careful.
Best two in three wins.

Send for Catalogue of our Pneumatic Chipping and Riveting Hammers, Rotary Drills, Rammers, etc.

Philadelphia Pneumatic Tool Co.
1038 Ridge Avenue, Philadelphia.

NEW YORK. PITTSBURG.
CHICAGO. SAN FRANCISCO.

Foreign Agents:
Chas. Churchill & Co., London and Glasgow.
C. G. Eckstein, Berlin and Vienna.
Henry Hamelle, Paris.
V. Löwener, Copenhagen and Stockholm.

HF

Export Trade.—Browne and Frothingham Co. opened offices at 32 Broadway, New York, as a special department for the export of marine tools. This branch of this firm's business will be under the supervision of A. M. Fisher, who has just returned to this country after having spent three years in Japan.

Marine Boiler Building.—The new boiler shop recently erected by the Kingsford Foundry and Machine Works, Oswego, N. Y., is already crowded with work. The company opens the new year with orders for sixteen large marine boilers on its books, together with many orders for centrifugal pumping machinery and for various engines.

Hewson Steam Turbines.—We are informed that a Hewson multiple expansion steam turbine is being built at the plant of the Cramp Ship and Engine Building Co., Philadelphia, by the Hewson Steam Turbine Co., which has offices in the machinery department of the Bourse, Philadelphia. Circulars and information regarding this turbine can be had from the Bourse office.

Central Sales Offices.—On and after January 15, 1902, the general sales office of the Pennsylvania Steel Co. and Maryland Steel Co. will be located in Philadelphia, and all communications regarding sales, shipments, etc., should be addressed to H. F. Martin, general manager of sales, the Pennsylvania Steel Co., Girard Building, Philadelphia, Pa. A local sales office will be retained at the plant of the Pennsylvania Steel Co. at Steelton, Pa., and all business originating in the adjacent territory will be handled by Chas. W. Reinoehl, sales agent.

"A Motor that Motes."—The Bridgeport Machine and Motor Works, Bridgeport, Conn., prides itself on building a gas engine which the company claims is a "motor that motes." A great deal of information is given regarding this motor in a catalogue which is being distributed. The engines vary in size from about 2 horse-power to 12 horse-power. Among the special points of superiority claimed for the engines are simplicity, compactness, ease of starting, freedom from vibration, quiet running, no vapor under pressure, no explosive mixture stored in tank, no lamp to blow out, no stuffing-boxes to pack, and minimum cost.

Portable Riveting Machines.—John F. Allen, 370 Gerard avenue, New York, who manufactures portable pneumatic machines and other tools, has just received an order from the American Car and Foundry Co. for fifteen riveting machines to be used in the making of oil-tank cars. Mr. Allen has also just received an order for ten machines from the Western Railway Equipment Co., of St. Louis, which are to be used for the same kind of work. These orders were secured after other machines had been tried, the aim of the purchasers being to secure absolute tightness of the rivets. These riveting machines are already used in many shipbuilding and marine boiler shops, their long reach enabling them to cover the large plates now used.

Paint for Metal Surfaces.—The Specialty Paint Co., 1139 Park Row Building, New York, calls special attention to its "No. 4" paint for metal surfaces. The claims are made for this paint that it will stick; that it will stop rust; that it makes a most excellent foundation for other paint; that it will adhere to and protect raw metal and any other surface, and that it is not necessary to have the metal surfaces start to rust in order to make the paint stick; that the paint is not affected by heat, cold or weather; that it will save iron structures from those disfiguring and deteriorating rust streaks seen on most old structures, and many new ones; that it will stay on and protect metal after numerous coats of paint have been burned off. This paint is designed for a first or permanent coat, and should be painted over for best results. It is claimed to cost one-third less in price than other paints manufactured for use on metal surfaces. This paint has been on the market for twenty-five years. Full information regarding it can be had from the manufacturer.

New Launch Plant.—Mr. O. Sheldon, who for many years has had a large launch and yacht building establishment in South Boston, has moved to Neponset, Mass., where he has fitted up a large and complete shop which has all the latest improvements and appliances for the building of yachts and launches and for storing them in winter. Mr. Sheldon always carries in stock a line of launches of various sizes.

Dixon's Silica-Graphite Paint.—One of the most severe tests that paint has ever been put to is that of Dixon's silica-graphite paint, manufactured by the Joseph Dixon Crucible Co., Jersey City, N. J., which was used on the Union Railroad bridge at Rankin, Pa. This bridge is 2,328 feet long, and is designed for carrying molten metal from one furnace to another. The bridge is subjected to great heat, also to sulphur fumes from locomotives and river boats, as well as from adjoining furnaces. In painting the bridge, Dixon's silica-graphite paint has been selected.

Copper and Bronze Products.—The Taunton-New Bedford Copper Co., of New Bedford, Mass., is sending out a circular letter in which it calls attention to the superior products of its mills, which are especially devoted to the manufacture of articles of copper and its alloys necessary in ship and engine building and other kinds of marine work; yellow (muntz) metal sheathing dimension sheets, bolts and bars, sheathing, slating and boat nails, condenser and supporting plates, piston and pump rods; also the justly celebrated Parsons' manganese bronze in all the above forms, which is the finest article available for high-class marine work; the uniformity, finish and good wearing qualities of Taunton yellow metal scheathing is renowned. The company also manufactures pure copper sheets, bolts, bars, rods, nails, tacks, wire, etc., in great variety.

Pneumatic Tools.—Owing to the great rapidity with which its business has grown, the Philadelphia Pneumatic Tool Co., Philadelphia, Pa., has found it necessary to have much larger quarters and greatly increased manufacturing facilities. The contract has just been made for a large factory on Twenty-first street, below Allegheny avenue, in Philadelphia, alongside the tracks of the Reading Railroad. The building will be one-story, with basement, 96 by 130 feet, with side extension for boiler-house, 24 by 44 feet. The engine room will be located in the basement, where will be installed an 80 horse power engine, together with direct connected generating unit for lighting, etc. The roof will have four large lanterns or skylights, allowing plenty of light over the entire floor area. The main floor will be free from partitions, except in one corner, where the offices will be located. It is expected that the building will be ready for occupancy not later than May 1st, and a considerable number of machine tools are being installed.

Modern Marine Shops.—The Marine Iron Works, Chicago, are entitled to praise for their energetic action in erecting new and modern buildings to replace those that were destroyed in the recent severe fire. The new buildings and equipment are greatly superior to the old, and include the highest grade of modern machinery, resulting in its being one of the most efficient plants of its kind for building high-grade marine engines, boilers, launches, tugboats and dredges. The disastrous fire of September 24th last completely destroyed every building of the old plant, and, among other valuable matter, a large amount of correspondence, many of the unanswered letters being held awaiting the completion of drawings and special details. This is a loss that cannot be replaced, for not only the original letters but also the addresses and records pertaining to them were completely destroyed. It is hoped, however, that the majority of the lost inquiries will be duplicated. The loss of catalogues, circular matter, engravings, photographs, etc., is now most keenly felt, and it will require considerable time and attention to replace them.

S. S. Zulia.—S. S. *Zulia*, of which we published plans and description in our issue of January, 1902, is almost an exact duplicate of the S. S. *Maracaibo* owned by the same people. John Haug, 206 Walnut Place, Philadelphia, Pa., informs us that the *Maracaibo* was built from plans and specifications prepared for him and that both vessels were built under his supervision.

Magnolia Metal.—The Magnolia Metal Co., whose New York office and factory was recently destroyed by a falling wall, has purchased an office building and factory at 115 Bank street, New York, which it is equipping with the most modern appliances for conducting its business and which it will have ready for occupancy early in February. At present the company is supplying the eastern trade from its factory at Stirling, N. J. It also has factories in Chicago, Montreal, Canada, and, with the addition of its New York factory, will be well prepared to meet all demands promptly.

Nolek Packing.—Webb's Nolek stuffing-box packing, which is extensively used in shipyards as well as on board many vessels, is claimed by the manufacturers to be the equal of anything in the line of packing. It is easily applied and has a most excellent reputation for wearing qualities. It has been extensively used on many vessels, not only for main propelling engines, but for pumps, circulating pump engines, donkey engines and other uses. This packing is manufactured by Edward G. Webb and Company, 312 North Third street, Philadelphia, Pa. One of the strong points claimed for it is that it will not burn, as the fiber used is magnesiaized cotton. The packing is also made water tight.

Chicago Pneumatic Tool Co.—The executive board of the Chicago Pneumatic Tool Co. announce the following appointments: W. O. Duntley, vice-president and general manager; C. E. Walker, assistant general manager; Thomas Aldcorn, general sales agent; W. P. Pressinger, general manager Air Compressor department; Chas. Booth, manager Chicago office; S. G. Allen, manager New York office. The organization of the Chicago Pneumatic Tool Co., of New Jersey, has been completed, and on December 31, 1901, took over the following properties, namely: The business and plant of the Chicago Pneumatic Tool Co., of Illinois; the Boyer Machine Co., of Detroit; the Chisholm and Moore Crane Co., of Cleveland; the Franklin Air Compressor Co., of Franklin, Pa., and the New Taite-Howard Pneumatic Tool Co., Ltd., of London, England. The securities are $2,000,000 five per cent, twenty year gold bonds and $5,000,000 of common stock, which is the only kind issued. The company starts with a working capital of more than $1,000,000, of which more than 50 per cent is in actual cash. The earnings of the constituent companies for the last year were $700,000.

SPECIAL NOTICES.

Announcements under this heading will be inserted at the uniform rate of thirty-three-and-a-third cents a line. Lines average ten words each.

PERMANENT POSITION WANTED.

Permanent position is desired by a graduate engineer of several years' experience in naval and mercantile ship design construction, who has designed and superintended the construction of several steamships.

DESIGNER, care Marine Engineering.

ATTENTION SHIPBUILDERS.

Shipyard Superintendant wants to make a change, knows how to get the most out of a small plant and to develop same, and to manage a large one to the best advantage. Young man, member Am. Society Naval Architects, American stock, with no old fogy ideas. Claims to know shipbuilding thoroughly in its most modern phases, from designing to the finish, ready for sea. Good reasons for making change given proper enquirers. Confidential correspondence solicited. If the above is one of your needs, it is up to you, as I can substantiate every claim. Of course money is an object. Address,

H-U-S-T-L-E, care Marine Engineering.

The Yale Submarine Lamp.—The Yale submarine lamp has been adopted by the Italian Government after tests recently made at the Royal Naval Arsenal at Spezia. The departments having charge of the experiments with the new submarine boat, just completed for the Italian Government, have placed orders for a complete equipment of Yale submarine lamps with the Naval Electric Company, 95 Liberty street, New York. This submarine boat of the Italians has created quite a stir in Europe owing to the fact that Italy has produced so many prominent inventors. The design of this submarine boat has been kept a secret, but the general principles of construction have leaked out. It embodies some of the features of the Holland and the Lake submarine boats and possesses a similar contrivance to the diving door of the *Argonaut*. It is in connection with this diving door that the Yale lamp is to be used. The boat steals into a hostile harbor, sends out a diver with a powerful electric lamp so shaded as not to be visible at the surface, and cuts the electric cables leading to the submarine mine defenses.

For Advancement in Practical Engineering

STUDY HAWKINS' AIDS

Standard & Up-to-date

$11. for a Set
$1. per Month

Catalog free for the asking.

Theo. Audel & Co. PUBLISHERS, 63 Fifth Ave. New York.

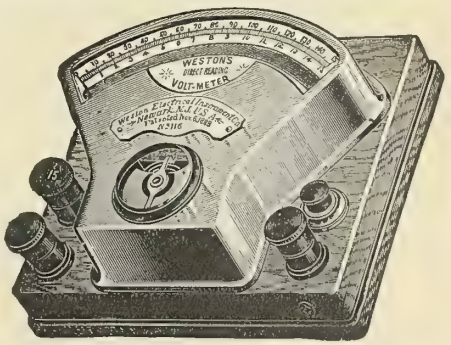
WESTON STANDARD PORTABLE DIRECT-READING

Voltmeters, Ammeters, Millivoltmeters, Voltammeters, Milliammeters, Ohmmeters, Portable Galvanometers, Ground Detectors and Circuit Testers.

Our Portable Instruments are recognized as **the standard** the world over. Our **Voltmeters** and **Ammeters** are unsurpassed in point of extreme accuracy and lowest consumption of energy.

WESTON ELECTRICAL INSTRUMENT CO.,
Waverly Park, Essex County, N. J., U. S. A.

BERLIN:—European Western Electrical Instrument Co., Ritterstrasse 88.
LONDON:—Elliott Bros., 101 St. Martin's Lane.



WESTON Standard Portable Direct Reading Voltmeter.

The Peerless Spiral Piston and Valve Rod Packing

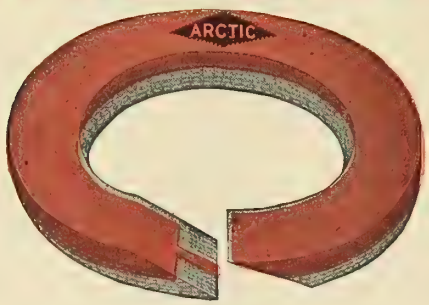
It will hold 400 lbs. of steam

Once tried always used

Will run twelve months in high speed engines

Arctic Packing

To be used exclusively for packing Ammonia Pumps



This packing is made in several hundred sizes

This packing is specially constructed for ice machine service, of layers of rubber and plies of duck which are so arranged and laid as to best resist the actions of ammonia, cold and heat.

The duck is a specially made duck, frictioned with an entirely new compound heretofore unknown to the rubber trade, and the core and back is of the celebrated Rainbow Packing compound, which is specially adapted to resist ammonia, cold and heat.

This packing is constructed on a strictly scientific basis, and the results obtained thus far have demonstrated fully its value for ammonia packing.

This packing is made in several hundred sizes. The rings may be slipped onto the rod very readily.

The usual rule is to be observed in giving measurements, the depth and width of stuffing box and size of piston rod, in order to get the size desired.

Sole Manufacturers of the

Celebrated Rainbow, Eclipse Sectional Rainbow Gasket, Hercules Combination and Honest John Packings.

MANUFACTURED, PATENTED AND COPYRIGHTED EXCLUSIVELY BY

THE PEERLESS RUBBER MANUFACTURING COMPANY

16 WARREN STREET, NEW YORK.

16-24 Woodward Ave., Detroit, Mich. 202-210 S. Water St., Chicago, Ill. 17-23 Beale St. and 18-24 Main St. San Francisco, Cal.
400-412 Common Street, 201-207 Tschoupitoulas St., New Orleans, La. 1221-1223 Union Avenue, Kansas City, Mo. 634 Smithfield St., Pittsburg, Pa.

These Goods Can be Obtained at All First-Class Dealers.

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" 91, Robert Davidson, 17 Fairfield Ave., Harbor Sta., Ashtabula, Ohio.
" 92, H. E. McArthur, Courier-Herald Bldg., 3d floor, Saginaw, W. S., Mich.
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" 94, George R. Jones, Box 222, Washington, N. C.
" 95, A. P. Jerguson, Box 198, Key West, Fla.
" 100, Jas. P. Lynch, Honolulu, H. I.
" 101, Thos. J. Hanlon, Box 765, Norfolk, Va.
" 102, Fred W. Linsemeyer, 210 Clinton St., So. Haven, Mich.
" 103, C. H. Hall, Box 512, New Berne, N. C.
" 104, J. H. Blumer, Moss Point, Miss.

TRADE PUBLICATIONS.

The type of gas engines manufactured by the C. H. Blomstrom Motor Company, Detroit, Mich., is well shown on a circular which is being distributed.

Steam plant thermometers and gauges have a special catalogue devoted to them by the Hohmann and Maurer Manufacturing Company, Rochester, N. Y. The catalogue is very neatly printed and contains many excellent illustrations of thermometers and gauges of different kinds, together with much valuable information regarding the general subject.

The Truscott Boat Manufacturing Company, St. Joseph, Mich., is distributing a neat booklet which tells "why a Truscott boat is the best"—to quote from the cover—also the special features of the gas engine which this company manufactures. The catalogue is very fully illustrated and well worth a perusal by anyone interested in gas engines and launches.

Direct Connected Units is the title to Bulletin No. 100 now being distributed by the Racine Hardware Company, Racine, Wis. It contains 16 pages and is very handsomely printed in two colors. There are many combinations of the Racine automatic engine with dynamos of different types and shapes. On the back page is a picture of the Racine twin marine engine. Copies can be had by referring to Marine Engineering.

Users of paint will read with interest a booklet being distributed by the Goheen Manufacturing Company, Canton, Ohio, entitled, "The Story of Human Progress." It contains many pictures of modern steel buildings in which the steel work has been protected with the carbonizing coating which this company manufactures. A number of letters are given from various lines of engineering work, speaking in the highest terms of the lasting qualities of this coating. The pictures are particularly interesting.

The pumps and other hydraulic machinery manufactured by the Deming Company, Salem, Ohio, will be found fully illustrated and described in a large catalogue known as Number 21, copies of which can be had by referring to Marine Engineering. This catalogue, comprises 294 pages and is neatly bound in flexible cloth. There is almost no limit to the variety of pumps which are here referred to. There are illustrations in great variety, so that each pump is fully explained both by picture and by concise description accompanying it. The innumerable tables throughout the book give a great deal of information regarding capacities, stroke, discharge, suction, etc. The variety of pumps shown includes almost everything used for marine purposes, from small hand deck pumps to bilge pumps, oil pumps, fire pumps, wrecking pumps, etc.

A catalogue of marine specialties will be sent to every reader of Marine Engineering who refers to this magazine, describing a very complete line of marine specialties, by the American Ship Windlass Company, Providence, R. I. The catalogue comprises 260 pages, and is devoted primarily to the complete list of windlasses and capstans which this company manufactures. Both of these devices are shown in great variety and a great deal of information is given regarding them, together with almost numberless illustrations Among the other specialties are various steam attachments for windlasses, patent iron bitts, Winter's automatic lubricator for worm gears, barring engines, yacht engines of various types and sizes, yacht mast winches. centerboard winches, improved stockless anchors, steam gypseys, tables of many kinds regarding anchors and chains, steam piping for windlasses and towing machines, etc., winches for hand cargoes, schooners and barges, and for various other purposes, hoisting engines, wharf drops, chain indicators, together with a great deal of information regarding the towing machines which this company manufactures.

The several types of engines, feed pumps and heaters, condensing apparatus, marine boilers, complete steam craft of various types and other specialties manufactured by the Marine Iron Works, Station A, Chicago, will be found very practically illustrated and described in a 24-page catalogue which is now being distributed. It is unusually well printed and contains much matter which will interest every one of our readers.

Users of hammers will find a valuable catalogue in the one issued by the David Maydole Hammer Company, Norwich, Chenango County, N. Y., which illustrates and describes in much detail the Maydole hammers. These tools are made of solid crucible cast steel in almost inconceivable variety, as shown in the catalogue. The illustrations are printed in three colors and every type of hammer is shown. The catalogue comprises 38 pages with cover.

Deming Power Pumps is the title to Catalogue F which is now being distributed by the Deming Co., Salem, Ohio. These pumps are described as the "acme" of efficiency. This catalogue is a special one and is limited to triplex power pumps and deep well pumps. It comprises 52 pages and is very fully illustrated with a great variety of pumps, each type being concisely described. There are many tables of capacities, sizes and other such information such as any user of a pump would wish to know.

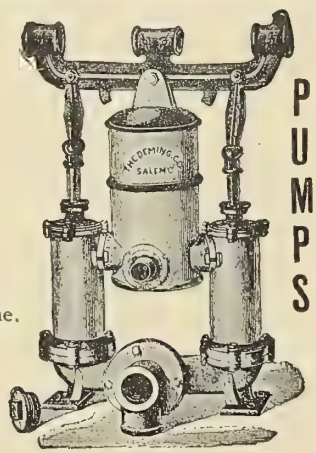
An Advertisers' Follow-Up System has been devised for mechanical and class advertisers who are interested in knowing the traceable results of each and every advertisement or medium which he advertises in, as well as other forms of publicity. Many crude and imperfect methods of keying ads have been tried and abandoned as unsatisfactory and misleading. There has been a great demand for a practical system, which shall show both the cost of publicity and the results in inquiries and sales, for ready comparison. This problem seems to be the nearest yet solved through the use of the "Advertisers' Follow-Up System" in the form of a loose leaf book, size 11 by 16 inches, designed and perfected by Frank M. Ho-glen and Clarence P. Day, for the purpose of easily and quickly recording every inquiry and sale produced through publicity, tracing and posting each inquiry and sale to its true source, besides keeping a check on each and every advertisement and medium, thereby eliminating all theory and guesswork as to the real paying qualities of the mediums used. The book is handsomely bound in patent loose leaf covers, has double index and enough ledger pages to last for years. Extra loose sheets may be inserted at any time and the old sheets removed and filed away when completed. Unfortunately there is not attached to the book a mechanical prod which will force advertisers to give the proper attention to designing and changing their advertisements. Further information and price may be had by addressing Ho-glen and Day, Rooms 1305-7 Nassau-Beekman Building, New York.

Ship's Deck, Bilge, Triplex Power

PUMPS

We make
HAND AND POWER PUMPS
for all purposes.
Send for Catalogue.

The Deming Company,
SALEM, OHIO.
HENION & HUBBELL,
Gen'l Western Agts., Chicago Ill.

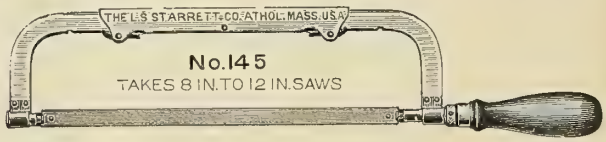


PUMPS

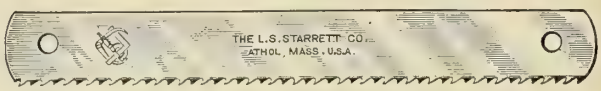
AMONG THE FINE MECHANICAL TOOLS WHICH WE MANUFACTURE FOR THE USE OF ENGINEERS AND MACHINISTS

ARE

Hack Saws and Frames



FOR SAWING TUBING, BRASS, COPPER AND SHEET METAL.



These blades are made of the finest steel; the teeth are sharp and too hard to file.

Every Engineer should have them among his tools.

The L. S. Starrett Co., Athol, Mass.

A copy of our Catalogue No. 16 L can be had for the asking.

The ice machine supplies, manufactured by the Triumph Ice Machine Company, Cincinnati, Ohio, will be found fully described in catalogue C, which is now ready for distribution. This catalogue is neatly printed on coated paper and bound in dark green cover. It contains 48 pages and has many illustrations of all sorts of supplies used in refrigeration. Anyone who is interested in the subject of ice machines will find one of these catalogues very instructive.

For Steam Making Refrigerating Apparatus

MECHANICAL THERMOMETERS

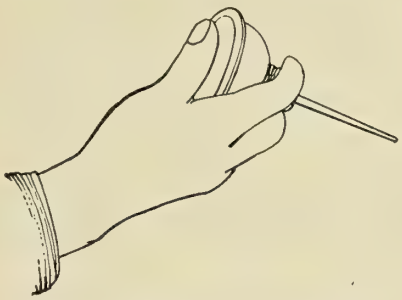
H&M TRADE MARK

HOHMANN & MAURER MFG. CO. ROCHESTER, N.Y.

For All Engineering and Manufacturing Purposes

Write for Illustrated Catalogue M.

NEW YORK 85 Chambers Street
CHICAGO 119 Lake Street
LONDON 57D Hatton Garden



The Nicest Thing

You can use is

DIXON'S

Pure Flake

GRAPHITE

in an ordinary

SQUIRT CAN.

For valves and cylinders and all bearings there is nothing to equal Dixon's graphite. Sample free.

JOSEPH DIXON CRUCIBLE CO., JERSEY CITY, N. J.

The mechanical rubber goods manufactured by the George W. Knowlton Rubber Company, 72 Broad street, Boston, Mass., are concisely described and illustrated in an 8-page catalogue with cover which is now being distributed. Among the several specialties referred to are ring packing, high pressure marine steam packing, spiral packing, pump packing, flax packing, molded wire gaskets, etc.

A booklet of designs of modern launches, fast cruisers and speed boats is published by Harry J. Perkins, Naval Architect, Grand Rapids, Mich. It contains 18 pages, each page having an engraving of a boat of some kind, showing in considerable detail its design and arrangement. Some of the pictures are halftone engravings, others are line drawings. Anyone who is at all interested in the subject of these several types of small craft will find this booklet very interesting. We infer that sample copies can be had free by referring to Marine Engineering.

The Toquet Launch and Motor Company, Saugatuck, Conn., is distributing a neat catalogue printed in two colors, describing the various types of launches which this company manufactures, also its gas engines and accessories.

The hydraulic valves and fittings of the Watson-Stillman Company, 204 East Forty-third street, New York, are fully illustrated and described in Catalogue 63. This catalogue comprises over 100 pages and is printed on heavy coated paper; there are illustrations almost without number, together with tables of prices, sizes, etc. Very few catalogues are as complete or as well-conceived as this is. Any of our readers who have to do with hydraulic and similar work will find a copy of this catalogue of much value for reference.

The Pierce vapor and marine engines and complete launches will be found fully described in a catalogue which is being distributed by the Siegel-Cooper Company, Sixth avenue and 18th street, New York, which controls the Eastern territory for the sale of these engines and launches. The catalogue comprises 48 pages and is very neatly printed in two colors. Launches of many sizes and types are shown, including side wheel and stern wheel boats for shallow waters. There are also many testimonials. Copies can be had by referring to Marine Engineering.

The course in navigation which has been established by the International Correspondence Schools, Box 1111, Scranton, Pa., will be found fully described in a 32-page booklet which is now being distributed. In order to have the subject thoroughly understood, the system of instruction as carried out at this school is fully explained, and much information is given regarding its books, papers, etc. The balance of the pages are devoted to explaining in much detail the system of instruction and how navigation is taught. This refers to both lake navigation as well as to navigating the sea. A synopsis of the many subjects occupies a dozen pages or so, making it possible for the prospective student to procure a thorough idea of the course.

A Little Blue Book On Rope Transmission is the title to a beautifully published booklet issued by the American Manufacturing Company, 65 Wall street, New York. It is very handsomely and profusely illustrated and printed with unusual taste in two or more colors, and is bound in a neat blue paper cover. The subject matter covers not only the subject of rope transmission, but gives a great deal of information regarding the material used by this company in manufacturng rope and cordage, and the manner in which the manufacturing is done is fully illustrated. There is also much information regarding splicing, etc. So popular has this book been that this is the third edition that it has been necessary for the company to issue. Copies will be sent free to our readers who refer to Marine Engineering.

Walworth Mfg. Co., 130-136 Federal St. BOSTON

Specialty of **BRASS VALVES** and Fittings for Marine Construction

Extra Heavy Valves, Bent Pipe and Fittings for High Pressure Work

Sole Manufacturers of

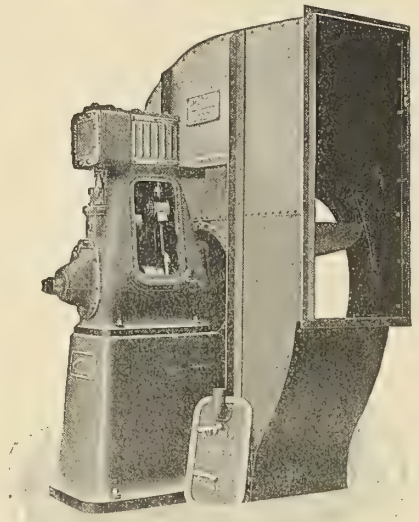
Van Stone Pipe Joint

Which does not Weep under heavy pressure

Send for Catalogue **N. Y. Office: Park Row Building** Prices and Terms on Application

BUFFALO STEEL PLATE FANS

FOR FORCED COMBUSTION



BUFFALO FORGE COMPANY,

BUFFALO, N. Y.

City Air quickly ruins in color and substance painting based on white lead.

ZincWhite

Is the obvious alternative. Unaffected by any atmospheric influences, it retains its beauty and protective value longer than any other white pigment.

FREE—Our Practical Pamphlets:

"The Paint Question,"
"Paints in Architecture,"
"House Paints: A Common Sense Talk About Them."

THE NEW JERSEY ZINC CO.

11 BROADWAY, NEW YORK

Spray Pumps and Nozzles is the title to a catalogue now being distributed by the Deming Company, Salem, Ohio. Pumps of this kind are illustrated almost without limit and a great variety of accessories is shown.

Neatly lithographed desk blotters and calendars are being distributed by M. W. Fogg, 202 Front street, New York, referring briefly to the mattresses, bedding and marine upholstery which he manufactures and which are his specialty.

Marconi Wireless Telegraph Up to Date is the subject of an 8-page booklet which is sent to all inquirers by Wyman and Gordon, Worcester, Mass. Only incidental reference is made to the facilities of this firm for manufacturing forgings of all kinds.

The Norwalk Launch Company, Norwalk, Conn., is distributing a neat catalogue which describes not only the launches which this company manufactures, but also the special features of the Norwalk gas engine, together with a new type of atomizer and a new muffler.

Users of search lights will find an instructive folder in the one issued by the American Acetylene Company, Masonic Temple, Minneapolis, Minn. A number of illustrations are given showing fully the construction and the operation of this search light, and pictures of the generating apparatus will also be found.

New Jersey copper Paint is evidently very popular, judging by the vast collection of testimonials printed in a booklet which is now being distributed by the New Jersey Paint Works, Jersey City, N. J. The booklet contains a great deal of information regarding the several kinds of submarine and other paints which this company manufactures.

A Typical Webster Plant is the title to a neat folder being distributed by Warren, Webster and Company, Camden, N. J. It refers briefly to the very large installation which this firm has made of the Webster system of steam circulation. Webster feed water heaters and purifiers and Webster oil and steam separators in a large manufacturing plant in the West.

Users of boat hardware will receive, upon sending to C. D. Durkee & Co., 3 South street, New York, "A Sure Sign of——" The balance of the pages of the folder explain fully what the sign is.

Users of portable ratchet wrench drills will find a tool of this sort well illustrated and described in a 4-page folder which is being distributed by the Universal Manufacturing Company, 22 China street, Cleveland, Ohio.

Very neat calendars are issued by the Fort Wayne Electric Works, Fort Wayne, Ind. On one side is a calendar for the month and on the back a calendar for the year. We infer that copies of these calendars can be had by any of our readers upon applying for them.

The roller grates, manufactured by the New England Roller Grate Company, are excellently illustrated and briefly described in a folder which is being distributed by this company. This business, which was formerly in Boston, has recently been removed to Brightwood, Mass. The grate is described as a practical shaking grate, a genuine fuel economizer and smoke preventer.

The State Steam Engineering School, under the management of James Coyne, 27 Tremont Row, Boston, Mass., will be found well described and illustrated in a neat booklet now being distributed. This booklet gives much information regarding the scope of the school and shows in illustrations the many facilities for giving practical information in steam engineering.

The Craig Ship Building Company.—The Craig Ship Building Company of Toledo, O., has just been organized to carry on on a larger scale the business which has been so successfully established and managed by John Craig. The new company also takes possession of the property of the Toledo Dry Dock Company. The capitalization is $1,250,000. The officers of the new company are: President, John Craig; vice-president, E. W. Tolerton; treasurer, John F. Craig; secretary, A. H. Morrill, and general manager, George Craig.

BUSINESS NOTES.

Orders for Sails.—Messrs. Wilson and Silsby, Rowes Wharf, Boston, Mass., received an order a few months ago for sails for a racing yacht called the *Speedwell* from New Zealand. All of the yachts in those waters were fitted either with sails made locally or with sails imported from England; and it was a great surprise on Regatta Day to local yachtsmen to have the *Speedwell* carry off the first prize by nearly six lengths. During the past few months, Wilson and Silsby have received orders from all corners of the world, particularly from Scandinavian and English yachtsmen. It is also understood that Wilson and Silsby are making a set of sails for the German Emperor's yacht *Meteor*, which will be used in her trip across the Atlantic. The sails, as well as the awnings, hatch covers, boat covers and other canvas goods for Commodore Bigelow's beautiful new steam yacht *Pantooset* were also furnished by Wilson and Silsby.

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Captains of Industry.—Mr. John Markle, president of the Sprague Electric Company, and Lieut. Frank J. Sprague, technical director of the same company, were included in the "Captains of Industry" who gave the luncheon in honor of Prince Henry at Sherry's, February 26th.

A Fine Steering Outfit.—The steering apparatus on the German Emperor's yacht *Meteor* was designed and built under the supervision of George Loud, treasurer and manager of the Edson Manufacturing Company, 132 Commercial street, Boston, Mass. This work was in line with Mr. Loud's extensive experience, as he also furnished steering gear for the *Independence*, the *Volunteer*, the *Puritan*, the *Mayflower* and many other famous yachts. Ball bearings were used in the *Meteor's* apparatus. The wheel is 54 inches from tip to tip. The hub is of highly polished brass and there are ten rosewood spokes. The felloes are of teak and the rim of ebony. Where the main spoke passes through there is inlaid in the rim the coat of arms of the German Emperor done in gold and silver. These and other decorations make probably the most beautiful steering wheel ever made.

The New Factory of M. W. Fogg.—Mr. M. W. Fogg, the well known manufacturer of cushions, mattresses and bedding for yachts and steamships, has recently occupied a new factory and wareroom at the corner of Fulton and Front streets, New York City. The building has undergone extensive repairs, and is now thoroughly equipped for carrying on a large business in these special lines. All machinery necessary for preparing the hair mattresses, etc., is driven by an electric motor. The three upper floors of the building are devoted to the manufacture of the mattresses and cushions, and the lower floor, handsomely decorated, is the salesroom where can be seen the various styles of upholstery furnishings and hangings. In this new factory the facilities of business have been increased and deliveries can be made promptly.

Free Samples of Wisconsin Graphite Products.—Wisconsin graphite paint has been most universally acknowledged by users of paint to be one of the best for all purposes for which a paint of this nature is used. It comes in six different shades, has a bright lustre and an even surface, and will outlast most any similar preparation. The claim is made that it practically incorporates itself into the iron and steel wherever applied. The Wisconsin Graphite Company, North Side, Pittsburg, Pa., has a most excellent graphite preparation, known as the Wisconsin Graphite Stack Paint, which will wear for years and is being largely used on board steamships, yachts, etc., throughout the country. This company manufactures the well-known Wisconsin Flake Graphite Lubricant, which not only obviates friction, but is without grit and is absolutely smooth. It will be well for users to consider the claims for Wisconsin Lubricant, as it is especially adapted for propelling engines, dynamos and machinery. A free sample will be sent to anyone upon request.

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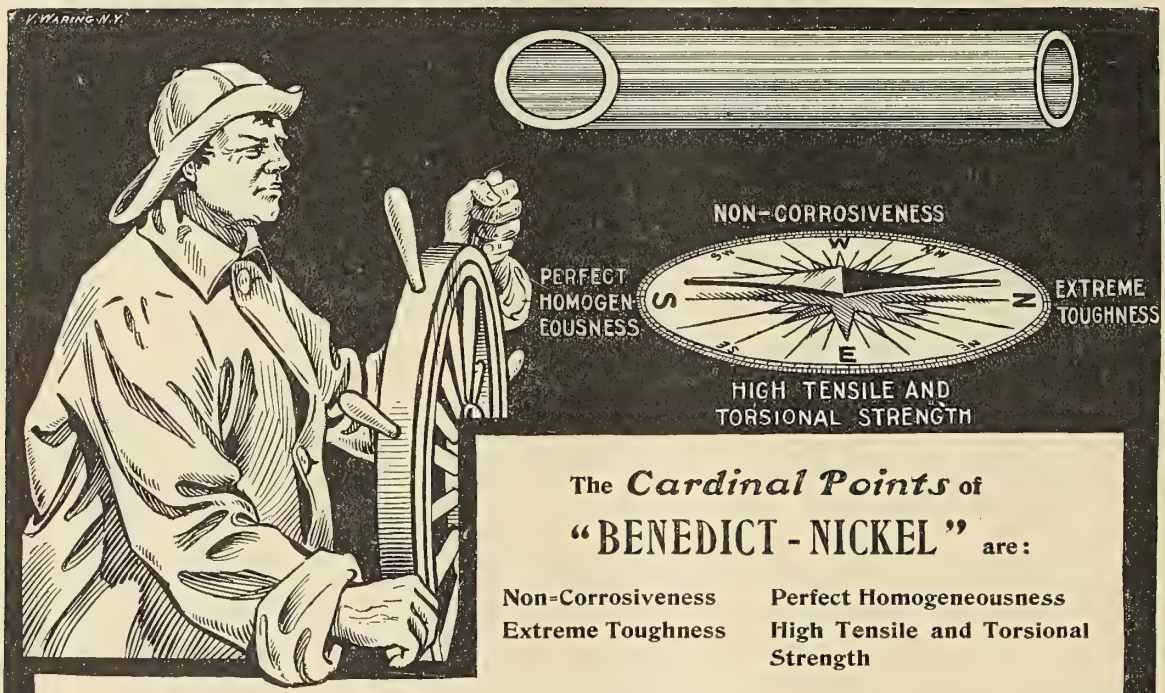
Buffalo Forge Company's Specialties.—The Buffalo Forge Company, Buffalo, N. Y., has many large and important orders on hand for its various specialties. It is installing a large heating and ventilating plant at the works of the American Smelting and Refining Company; a heating plant in the Siegel-Cooper Company store, New York, and drying plant in the Abendroth and Root shops for drying galvanized iron work. By substituting this system for the old-fashioned methods of drying, it is believed that the time will be reduced at least one-fourth of that formerly consumed. Less space is also occupied. The Buffalo Company is building a fan for use in mine ventilation which has a 250-inch housing and is constructed throughout of steel plate rigidly stiffened and braced. The rotating element of the fan will be driven by a direct-connected horizontal engine, which has a speed of 150 revolutions per minute. This fan is built to deliver 125,000 cubic feet of air per minute at ordinary working speed.

Free Catalogue of Besly Specialties.—We are informed by Messrs. Chas. H. Besly and Company, 10-12 North Canal street, Chicago, Ill., that there is no let-up of any kind in their business. As many orders as ever are being constantly received for their well-known Gardner grinder with spiral ground disks, recent shipments having been made to California, Washington, Oregon, Wisconsin, Ohio, Pennsylvania and elsewhere. The grinder has proved one of the most popular specialties that this company has ever had. The hundreds of users of this grinder are very liberal in their orders for spiral circles, which are made from emory and corundum, or from corundum alone, and which, it is claimed, will do from 50 per cent to 200 per cent more work than usual grinding surfaces. This firm is also receiving many orders for Helmet oil Badger and Bonanza cups. A copy of this firm's catalogue, giving full information regarding all the specialties handled, with discount sheets, will be mailed to anybody upon inquiry. .



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These qualities make "Benedict-Nickel" peculiarly adapted for condenser tubes, and for every other purpose where highly non-corrosive tubing is required.

These are the best tubes for condensers ever devised. They positively resist electrolysis. They have steadily gained in favor with leading engineers and high naval authorities *because they do exactly what we claim for them.*

Their manufacture has long since passed the experimental stage. Their superiority over copper and brass tubes has been demonstrated by *actual use.*

The basis of the high non-corrosiveness of "Benedict-Nickel" is its inert nature, due to the combining of nickel with copper. The metal contains no zinc nor any other weakening metal. It is perfectly homogeneous.

The tubes are hot-rolled from solid cylindrical billets, not cast on a core, and given a twist formation like that of a gun barrel. Hence their great tensile and torsional strength.

We publish a "Treatise on Electrolysis of Condenser Tubes," which gives the full scientific reasons for the superiority of "Benedict-Nickel." Send for it.

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ENGINEERING DATA.

There has been such a demand for engineering data in compact form that we have established a bureau for this purpose.

The plan is to supply 20 cards a month. These cards are to give information regarding new vessels, such as has appeared in the columns of Marine Engineering and in other publications; also data regarding ship riveting, labor costs per ton dead weight in England and on our Great Lakes; data regarding boilers of different types; dimension weights and horse power per ton of various types of vessels; fuel economy on large ships per one hundred-ton miles; prices of battleships for the United States Navy per knot ton and per horse-power ton; similar data regarding cruisers and other naval vessels, design dimensions of engines, new formulæ; in fact, all current data useful to the practical designer and engineer, etc.

These cards will be of the standard library size, suitable for filing with personal data, in the standard library index boxes.

This service will include 20 cards a month, or 240 cards a year. The price is as follows:—

One year	$4.00
Six months	3.00
Three months	2.00

In many instances special data can be furnished, when desired, at a slight advance in cost.

Fuller information regarding this service can be had upon application to

MARINE ENGINEERING,
309 Broadway, New York City.

Buffalo Feed Water Heater and Purifier.—The Northern Steamship Company of Buffalo, N. Y., which has been thoroughly overhauling the steamships *Northwest* and *Northland* by installing new boilers and making other improvements, has ordered from Robert Learmonth, Buffalo, N. Y., Buffalo feed water heaters and purifiers for each ship.

The Litharge Paint.—The Litharge Paint Company, 103 East Lombard street, Baltimore, Md., has had the severest tests made of this paint by the principal steamship lines running out of Baltimore. The Atlantic Transport line, after testing it on the hulls of its ships, stacks and boilers, is now covering the entire ship with it. Mr. W. H. Johnson of that company writes that after the paint had been on the stacks and boiler doors for two months it had a good hard gloss to it, and was in good condition. It was put on the hull of the steamer *Juniata* of the Merchants' and Miners' Transportation Company, also on the boiler doors and on the side plates in the hold. The captain reports that it is in excellent condition, and to be better than anything he has ever seen. Litharge Paint is exclusively manufactured by The Litharge Paint Company, who invites any well-known company which may be in need of a paint better than it has, to make any test whatever of this paint. It is especially made for marine and submarine work, and is not affected in the least by changes of climate, acids, soot, heat, etc.

Important Coroner's Jury Verdict.—It will be recalled that on November 26 last a terrific and fatal accident occurred in the boiler plant of the Penberthy Injector Company, Detroit, Mich. A coroner's jury has spent over nine days making a very exhaustive investigation of the cause of the accident. The verdict, which completely exonerates the Penberthy Company and the engineer, states that the company and its employees had given proper care and attention to the boiler, but that scientific and expert testimony presented to the jury showed that the boiler was not constructed of the material nor in the good workmanlike manner called for by the specifications furnished for its construction, and, therefore, that the makers of said boiler are responsible. After the testimony was all in, the verdict was reached by the jury in less than two hours. The Penberthy Company has secured control of a large tract of land in Detroit and expects to build immediately a larger plant and to equip it with all of the very latest improved mechanical devices. In commenting upon the verdict the Detroit *Journal* speaks editorially in the most complimentary terms of the care which the Penberthy Company gave the steam plant.

Towing Machines.—We are informed by the American Ship Windlass Company, Providence, R. I., that the Standard Oil Company has taken up the subject of tow barges as general freight carriers, something on the lines of the article which appeared in the February issue of Marine Engineering. The company is now building two steamers of 12,000 tons capacity each; two tow barges of 12,000 tons; and is also building two oil barges of about 8,000 tons. Mr. Frank S. Manton, agent of the Ship Windlass Company, reports that the Standard Oil Company has ordered six of this company's towing machines, and that he also will put towing machines on the barges as well as on the steamers. In this way there will be a relief from strain simultaneously at both ends of the hawser if both towing machines are at work at once. Probably in ordinary weather only one towing machine will be used, although the motion of a long hawser would be easier with both machines at work. The large towing machines which are to be put on the vessels will each carry 300 fathoms of two-inch in diameter steel wire hawser, so that by shackling the two hawsers together there will be a length of 600 feet. Between the 1st and the 15th of January, the American Ship Windlass Company sold ten towing machines, and, in the middle of March, received a cable order from Russia for two machines.

A Large Gas Engine Business.—The Grant-Ferris Company, Troy, N. Y., makers of the Howard hydrocarbon motors, both two and four-cycle types, comprising a variety of fourteen sizes, has been successful in competition with a number of prominent gas engine builders, in securing a large contract from the Steel Boat Construction Company, of H. Scherer and Company, Detroit, Mich., for 250 motors; all to be delivered this season. The schedule calls for graded sizes in lots of fifteen to twenty-five each. This order on top of previous contracts with other firms gives the Grant-Ferris Company plenty of motor business.

A New Machine Company.—The Iroquois Machine Company, 150 Nassau street, New York, has recently been organized by W. W. Gibbs and others. The company will manufacture quite a line of improved machinery, including a full line of automatic and plain drop hammers, swagging machines, rolling mills, roller bearings, grinding machines, etc. The company is understood to have ample capital back of it. It has purchased the plant and business of the Universal Machine Company, Providence, R. I., and has rented large adjacent buildings so that business is organized at once on a comprehensive scale.

Small Gas Engines.—A small gasoline motor under one-horse power must be proportionately stronger in combination with fewer parts and greater simplicity than its larger brothers. These points are found in the new model, special 3-4 horse-power motor manufactured by the Fairfield Motor Company, Bridgeport, Conn. It is not only neat and strong in appearance but the acme of simplicity. The igniter is entirely new in design, extremely simple, with but one spring and no small, delicate or trappy parts. The cylinder and cylinder-head are water jacketed. It has a bronze circulating pump, and all fittings, including the vaporizer, are of the same quality as on the regular line of large engines. It is one of the smallest practical 2-cycle engines ever offered that is not a toy, but made for hard work.

Correspondence Instruction.—An unfortunate tendency among most students who are anxious to fit themselves for special lines of work is to skim over the elementary lessons as hurriedly as possible. The American School of Correspondence, Boston, Mass., believes that one of the leading causes for its success in instructing students is the fact that it has given such careful attention to elementary work, so that students have been able to understand much more thoroughly the subjects which they have undertaken to fit themselves in. When books were more expensive and papers were few, it was a difficult thing for a man of limited education to secure the advancement in his occupation that he deserved; now, however, by means of the instruction papers and other literature which this school furnishes, a man is enabled to continue with his regular work and, at the same time, by correspondence instruction, secure a very comprehensive grasp of any line of work which he prefers to undertake. Full information regarding the papers and books, as well as the courses offered by this school, can be had by writing for them.

SPECIAL NOTICES.

Announcements under this heading will be inserted at the uniform rate of thirty-three-and-a-third cents a line. Lines average ten words each.

WORKING DRAWINGS OF GAS ENGINES WANTED.

We desire to secure working drawings of marine gasoline engines of the 4 cycle type, or about 4-horse power.
GAS ENGINES, care Marine Engineering.

SHIPYARD SUPERINTENDENT WANTED.

The Superintendent of our shipbuilding department has resigned his position and no successor has yet been appointed.
RISDON IRON WORKS, San Francisco, Cal.

WANT SOME GOOD SPECIALTIES TO SELL.

A machinist and marine engineer, with American and English first-class licences, intends making an extended visit in June to the vicinity of Glasgow, Scotland, and wishes to act there as agent for some firm or specialty so as to clear his expenses. Address, ENERGETIC, care Marine Engineering.

Asbestos Specialties.—The H. W. Johns-Manville Manufacturing Company, 100 William street, New York, has been awarded a number of very large orders lately for a sectional asbestos covering, for a number of large hotels and manufacturing establishments in all parts of the country.

Philadelphia Pneumatic Tools.—In order to more efficiently handle the rapidly growing business which has developed on the Pacific coast, the Philadelphia Pneumatic Tool Company, 1038 Ridge avenue, Philadelphia, Pa., has appointed Berger, Carter and Company, 330 Market street, San Francisco, Cal., representatives for the Pacific coast.

Williams Marine Paints.—Samuel J. Williams, who recently removed to 11 Broadway, New York, has already been obliged to increase his office facilities because of the increased demand for Williams submarine paint, Williams copper paint, Williams seam paint and Williams wood anti-fouling paint. In addition to these special paints, Mr. Williams supplies white lead, zinc, colors and everything else in the paint line.

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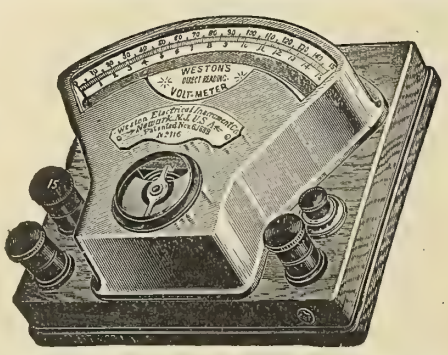

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" 6, Clifford E. Shrodes, Room 13, Railroad Exchange, 110 North Fourth St., St. Louis, Mo.
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" 13, Wm. V. H. Sheer, 1129 Venango St., Philadelphia, Pa.
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" 43, Thos. J. Coyle, 627 Superior St., Port Huron, Mich.
" 44, George Layman, 274 Third Ave., Manistee, Mich.
" 45, Jas. A. Rourke, 708 East Bay St., Savannah, Ga.
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" 51, Henry Connell, 28 Yuba St., Muskegon, Mich.
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" 103, C. H. Hall, Box 512, New Berne, N. C.

TRADE PUBLICATIONS.

Users of gas engines will find a very interesting catalogue in the one issued by the Eagle Bicycle Manufacturing Company, Torrington, Conn., which describes very thoroughly the gas engine manufactured by this company. The catalogue is very neatly printed in two colors with marginal headings, and the general style of the engine is shown by a large cut.

Users of interior telephones will be interested in a catalogue being distributed by the Clark Automatic Telephone Switchboard Company, 16 Custom House street, Providence, R. I. The general arrangement of the system is fully shown in the catalogue, and, as the system is intended for use on vessels as well as in offices and elsewhere, it will appeal to many of our readers.

The oil burners, forges, drop forgings and crucible furnaces manufactured by the Union Drop Forge Company, 80 East Ohio street, Chicago, Ill., have a special catalogue devoted to them. It is 6 by 9 inches in size and is well illustrated, containing a number of illustrations of each of the specialties referred to. The oil burning devices will be of special interest to our readers. Copies of the catalogue can be had by referring to Marine Engineering.

The kerosene oil engines manufactured by the International Power Vehicle Company, Stamford, Conn., are fully described in a catalogue which the company is now distributing. It is fully illustrated with fine engravings and the construction of the engines is well explained. The marine type of engine is fully described, as well as the stationary engines, and brief reference is made to the engines designed for motor vehicles. Everyone interested in explosive engines should have a copy of this catalogue.

Of interest to navigators is the title to a catalogue now being distributed by Riggs & Brothers, 310 Market street, Philadelphia, Pa. The catalogue is devoted to quite a variety of specialties which appeal to navigating officers, among them being the following: Patent depth gauges for taking soundings at any speed, improved sextants, improved ship's bell clocks, Pilot night glasses, the Neptune marine glasses, portable electric lights, compasses, chronometers, etc. Copies of the catalogue can be had free by referring to Marine Engineering.

The International Gas Engine Co., 26 Broadway, New York, has published an excellent catalogue describing very fully the gas engine which this company makes. The catalogue is 6 by 9 inches in size and comprises over 40 pages. It is neatly bound in heavy paper cover, is printed on coated paper and is well-illustrated. The illustrations of the engine are full-page size and many important parts of the engine are shown by means of smaller engravings. In the back part of the catalogue are many full-page pictures of yachts and boats of various kinds in which engines of this make have been installed. There are also many testimonials and users of the engine.

A beautifully illustrated catalogue has just been published by the F. W. Devoe and C. T. Raynolds Company, 101 Fulton street, New York. It is 9 by 12 inches in size and contains a great many full-page engravings of some of the best known steam yachts, giving the name of the yacht, as well as that of the owner, together with the length, breadth and depth. Opposite each picture in most cases is a letter from the master of the yacht speaking in high terms of some of the various specialties manufactured by this company. These specialties include marine white and black, hard enamel colors, smokestack paints, deck colors, deck varnishes, spar varnishes, etc. We do not know whether copies of the catalogue will be sent free, but they can probably be had upon request by addressing Dr. I. W. Drummond, of the Devoe and Raynolds Company and mentioning Marine Engineering.

When writing to advertisers please refer to Marine Engineering.

The Rhode Island Motor Co., Providence, R. I., is sending out to all inquirers folders regarding its gasoline engines. The folders contain pictures of the engines, together with information regarding sizes, finish, etc., and lists of boats' fittings which this company sells.

The Morris Blow-off Valve for boilers, which is manufactured by the Chapman Valve Manufacturing Company, Indian Orchard, Mass., has a special folder devoted to it which the company is now distributing. Several drawings are given, showing the design and application of the valve, and there is sufficient text to fully explain the value of these valves. Copies can be had upon application to the company.

The Long-Arm System Co., Cleveland, Ohio, now has ready for distribution bulletin No. 5. This bulletin gives the latest information regarding this company's system of power doors and hatch gears for the preservation of life and property at sea. A number of illustrations show the operation of the system and there is a complete description of the whole system, including the different styles of power stations and different styles of doors. The subject is one that will be of much interest to many of our readers.

The latest machine tool catalogue issued by Hilles and Jones Company, Wilmington, Del., is known as catalogue S. It is one of the striking novelties in the line of a catalogue of the season, being bound in burlap. The catalogue comprises 28 pages. Each page contains several illustrations of tools of some sort for working plates, bars, structural shapes, etc. It is a very handsome specimen of printing and is a valuable book for reference to anyone who has to do with machinery for boiler shops, plate shops, engine shops, and other parts of a shipyard.

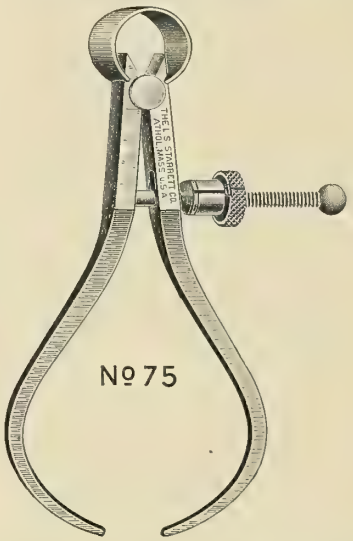
Catalogue No. 19, descriptive of the automatic and other injectors, ejectors, water gauges, lubricators, oil cups, grease cups, etc., manufactured by the Penberthy Injector Company, Detroit, Mich., is now ready for distribution and a copy can be had by any of our readers upon application. It is well presented in a dark green paper cover with the letters in gold. The text covers 68 pages. There are a great many illustrations and the text is evidently right to the point. What adds much to the completeness is a fine index. Every engineer should have a copy of this catalogue on hand for reference.

The many important features of Smooth-On iron cements for use on steam vessels of all kinds, in making repairs on engines and boilers, as well as any other iron apparatus, is well brought out in a catalogue issued by the Smooth-On Manufacturing Company, 547 Communipaw avenue, Jersey City, N. J. The catalogue is 4 by 7 inches in size, comprises 56 pages, and is very neatly published. It contains many illustrations of repair jobs which have been made with this cement, and gives full data regarding many which have been made on steam vessels and elsewhere. A number of very interesting jobs referred to were made on pitted propeller blades, as well as on hulls and machinery of steel vessels.

The Philadelphia Pneumatic Tool Co., 1038 Ridge avenue, Philadelphia, Pa., now has ready for distribution a 32-page catalogue giving a great deal of information regarding the pneumatic tools which this company manufactures. The catalogue is printed in two colors and is very fully illustrated with pictures of hammers for chipping, calking, riveting, etc., together with drills of all sorts, pneumatic riveters, foundry rammers, pneumatic hoists, etc. The size of the catalogue is 6 by 9 inches and many of the illustrations are nearly full-page size, making the catalogue of much value in showing practical applications of the several tools. The catalogue is not only very attractive in appearance but it contains much useful information regarding the uses of this particular line of machinery and contains tables of capacities, weights, dimensions, air consumption, etc.

As **EVERY ENGINEER** and **EVERY MACHINIST**

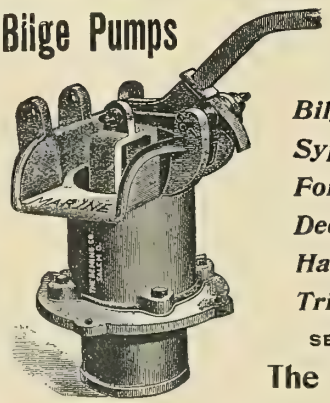
Uses Calipers, he should have only the best. We make them, both inside and outside, from 2½ to 24 inches. The No. 75 style is made in 5 sizes, from 2½ to 6 inches.



These Calipers are fitted with quick adjusting nuts, unless otherwise ordered.
Our Catalogue, No. 16L, of Fine Tools sent free.

The L. S. Starrett Company
ATHOL, MASS.

Bilge Pumps



We make a complete line of

Bilge Pumps,
Syphon Pumps,
Force Pumps,
Deck and other
Hand Pumps.
Triplex Pumps.

SEND FOR CATALOGUE.

The Deming Co.,
Salem, Ohio.

I have designed and built and applied for patents on a

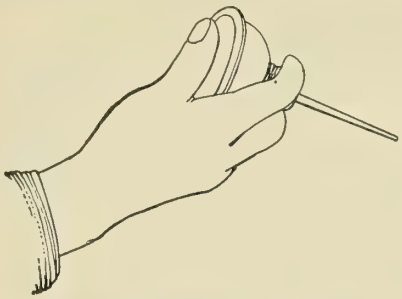
Compound Gas Engine

which has shown an efficiency of three times the ordinary explosive engine.

I believe this engine can be built in sizes from 5 horse power up into the hundreds and show great efficiency.

Manufacturers who are open to a proposition to build and put this engine on the market please communicate with

COMPOUND GAS ENGINE
309 BROADWAY NEW YORK
Care MARINE ENGINEERING



The Nicest Thing

You can use is

DIXON'S

Pure Flake

GRAPHITE

in an ordinary

SQUIRT CAN.

For valves and cylinders and all bearings there is nothing to equal Dixon's graphite. Sample free.

JOSEPH DIXON CRUCIBLE CO., JERSEY CITY, N. J.

Users of paint will want to send for a copy of an 8-page folder issued by the Joseph Dixon Crucible Company, Jersey City, N. J., descriptive of Dixon's silica-graphite paint. On each page is a very handsome picture of a large and fine bridge or other steel structure painted with this paint. The folder is sent out in the form of a mail card and is a very neat specimen of printing.

FOR SALE

25 COMPOUND ENGINES 25

Brand new, of tne Most Economical Type, for Stationary, Electric Light and Marine purposes

IMMEDIATE DELIVERY

Write, stating horse-power steam pressure and speed you require : : : : : :

CHARLES M. HEATH

Broad Street Bank Building, TRENTON, N. J.

The gasoline and kerosene launches built by W. R. Osborn, Croton-on-Hudson, N. Y., will be found well illustrated in a 6-page folder which is now being distributed. The folder contains considerable information regarding the engines and launches and other features of this business.

Users of pneumatic tools will want to send for a copy of an attractive catalogue now being distributed by the Columbus Pneumatic Tool Company, Columbus, Ohio, descriptive of this company's piston air drills. A number of illustrations are given showing the operation of these drills for doing certain lines of work which it is claimed that no other drill can do. The special features and characteristics of this drill are fully explained.

Two bulletins are being sent free to all inquirers by the Fort Wayne Electric Works, Fort Wayne, Ind., one descriptive of a new type of electric motor which this company manufactures, and the other of the corresponding type of generator. Each bulletin is of the same size and is very well printed. Each machine is illustrated intact and also taken asunder, showing the design and construction of the several parts. Anyone interested in electric machinery will find these bulletins of much interest.

One of the handsomest publications of the season is the catalogue of the Truscott Boat Manufacturing Company, St. Joseph, Mich., describing the launches and engines which this company manufactures. The catalogue is 7 by 7 inches in size, bound in a neat cover, and it is printed in two colors. The paper used is heavy coated paper, and the illustrations are very fine half-tone engravings. They are very numerous, giving a great many different pictures of engines, large and small, including sectional views which explain fully the construction and operation of the engine. There are also pictures of different types of boats which this company manufactures.

The Engineering and other specialties, manufactured by the Eastwood Wire Manufacturing Company, Belleville, N. J., are described in a very handsome catalogue, 4 by 7 inches in size, copies of which can be had free by referring to Marine Engineering. The catalogue is bound in a very neat cover of heavy red board and the text comprises 144 pages, well-printed and thoroughly illustrated. The first 75 pages are devoted almost exclusively to illustrations of all sorts of specialties, including valves of all types and designs, and valve fittings; cocks, unions and a great variety of other fittings; whistles and chimes of all kinds; fusible plugs, expansion joints, seamless drawn brass and copper tubing, gauge glasses, lubricators, bronze and iron propeller wheels, brass castings in great variety, etc. The catalogue contains a great many tables of interest to engineers, and altogether is one that should be in the hands of all of our readers. A complete index in the back part adds much to the completeness of the catalogue.

Walworth Mfg. Co., 130-136 Federal St. BOSTON N. Y. Office, Park Row Bldg.

Specialty of **BRASS VALVES** and Fittings for Marine Construction

Extra Heavy Valves, Bent Pipe and Fittings for High Pressure Work

SOLE MANUFACTURERS OF

WALWORTH FLANGED—OVER PIPE JOINT

Which does not Weep under heavy pressure

OUR BOOK CONTAINING "TABLES OF DIMENSIONS" OF WALWORTH GATE VALVES, FLANGED FITTINGS, FLANGED OVER PIPE JOINTS, WROUGHT IRON BENDS, ETC., should be in your draughting room.

BUFFALO FOLDING FORGES

Specially constructed for service on shipboard

COMPACT
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Designed for
Naval Service
Ship Builders
Miners
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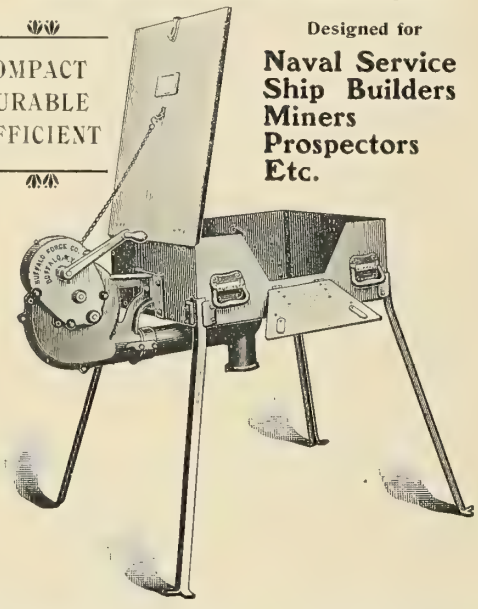

Buffalo Forge Company
BUFFALO, N. Y., U. S. A.

Better Life:

"I have always found that ZINC WHITE gives better life to the paint," said Mr. Armbruster at the last convention of the Pennsylvania Association of Master Painters.

Zinc White

Gives better life to paint because it retains longer the brilliancy of the original gloss and the purity of the original tints. It also gives longer life to the paint itself and to all the desirable qualities of paint.

FREE: Our Practical Pamphlets—
"The Paint Question"
"Paints in Architecture"
"House Paints: A Common Sense Talk About Them"

***The* NEW JERSEY ZINC CO.**
11 Broadway
New York

Up-to-date second-hand machine tools are dealt in very largely by the Garvin Machine Company, Spring and Varick streets, New York, and a partial list of such tools has just been printed. Copies of the list can be had upon application.

An American Invention, a Boiler Without Bricks, is the title to a catalogue being distributed by the Kingsley Patent Boiler Company, 30 Broad street, New York. The catalogue contains 32 pages, 7 by 11 inches in size. There are a number of full-page engravings showing the construction of the boiler and several line drawings which explain fully the detail of the arrangement.

Packing for Marine and Stationary Engines is the title to the latest catalogue issued by the United States Metallic Packing Company, 13th and Noble streets, Philadelphia, Pa. Typographically, it is a handsome catalogue and in size it is convenient for the pocket. There are 16 pages devoted exclusively to the subject matter. Half of the pages contain full-page engravings of this packing. A copy of this catalogue should be in the hands of every engineer.

The engineers' specialties, manufactured by the Peerless Rubber Manufacturing Company, 16 Warren street, New York, will be found very neatly illustrated and described in catalogue No. 50. The catalogue is pocket-size, comprises 40 pages, is bound in a neat red paper cover with gold lettering. The text is printed in two colors, and, like all of the publications of this company, is well done. Among the more interesting features of the catalogue are references to Rainbow packing, Peerless spiral piston and valve rod packings, Arctic ammonia ring packings, sheet and flange packing, Hercules combination metallic stop valve packing, Honest John hydraulic Rainbow core packing, and Success semi-metallic spiral packing, together with other forms of packing, special tubing for pneumatic tools and other forms of tube and hose.

The Grasselli Chemical Co., Cleveland, O., is distributing a very artistic catalogue printed in several colors, describing the ammonia and various other kinds of acids which are the specialties of this company.

The friction sensitive drill presses, manufactured by the Knecht Brothers Company, Cincinnati, O., will be found well-described and illustrated in a 12-page catalogue with cover, which is now being distributed.

Mechanical Draft, What It Is and What It Does, is the title to bulletin No. 46 now being distributed by the B. F. Sturtevant Company, Jamaica Plain, Mass. It is artistically printed in two colors, very neatly illustrated and the text is right to the point.

The search lights manufactured by the Rushmore Dynamo Works, Jersey City, N. J., are evidently very popular, judging by the list of names of vessels and users given in a booklet now being distributed. On the front page of this booklet is the statement: "Our best salesmen are the lights in use." The list of users is a surprisingly large one.

The gas engines and launches, manufactured by the Dutton Engineering Company, Perth Amboy, N. J., will be found well-described and illustrated in a catalogue which is now being distributed. Many pictures of different sizes and different views of the Dutton engine are shown, and also views of many boats in which these engines have been installed.

The automatic circuit breakers, manufactured by the Ward Leonard Electric Company, Bronxville, N. Y., are described with much thoroughness and are well illustrated in a 16-page catalogue, 7 by 10 inches in size, which is now being distributed. In addition to the descriptive matter and the many illustrations, the catalogue contains a great many tables giving much information regarding the capacities, sizes, prices, etc., of these circuit breakers.

BUSINESS NOTES.

Busy Launch Builders.—Palmer Bros., Cos Cob, Conn., made the largest shipments of gasolene motors to foreign countries in March that they have ever made in the history of the business. Among shipments reported were: 50 engines to their London agents, 5 engines to South Africa, and one each to Australia, Sweden and Holland.

Larger Pittsburg Offices.—The enormous business among steel manufacturers in Pittsburg, Pa., has not been felt more by any concern than by the Niles-Bement-Pond Company, 136 Liberty street, New York, because of the demand for machine tools. The company has now taken much larger offices than have been occupied heretofore, and are situated in the new Frick building.

Sprague Apparatus.—During the past month the Sprague Electric Company, 527 West Thirty-fourth street, New York, has had one of the largest lists of sales that has ever been made in the history of the company. There has been an especially large demand for Sprague Split Pole Generators. Many of them are for large sizes, going up into the hundreds, and are for leading concerns in all parts of the country.

Reeves Engine Company.—The business heretofore conducted by the Reeves Machine Company, Trenton, N. J., has grown so fast that the company has found it necessary to greatly extend its facilities for manufacturing. The name of the company has been changed to Reeves Engine Company, and it is understood that new buildings will be erected at once, so that the output of engines may be very largely increased. The new company has been incorporated with a capital stock of $400,000, with Clifton Reeves as president.

Davidson Apparatus.—The two gunboats now being built for the Mexican government at the Crescent Shipyard, Elizabeth, N. J., are to be fitted with a complete equipment of Davidson pumps and evaporating and distilling apparatus. The fishing steamer building at the same yard is also to be fitted with Davidson pumps. Pumps of same make have recently been supplied for yachts *Mohican*, *Vision* and *White Heather*, and dredges working in Manila harbor. These pumps, evaporators and instilling apparatus were manufactured by M. T. Davidson, 141 Broadway, New York.

Chime Whistle and Air-Pump.—The Bowen Manufacturing Company, Auburn, N. Y., is finding a very large sale for its chime whistle and air-pump combined for use on launches and small boats of all kinds where steam is not available. It is very easily operated by giving the handle a short, quick pull, and produces a clear, musical tone of sufficient volume to signal boats, lock and bridge tenders, at a distance of 1 mile or more. It is highly polished in brass or nickel as desired. At the same time it is no toy, but is built for business; is made of the best material and by the best mechanics. Both pump and whistle are made of seamless brass tubing; the pump is powerful; the whistle is a four-tone chime. If desired, the whistle can be placed at a distance from the pump, and connected with it by a rubber or metal tube or pipe.

Chicago Pneumatic Tools.—Since the absorption of the Standard Pneumatic Tool Company by the Chicago Pneumatic Tool Company, whose offices are in the Monadnock Block, Chicago, Ill., J. B. Hurley, who was formerly vice-president and general-manager of the Standard company, has been made manager of the Chicago company, with headquarters in the Chicago office.

For Steam Making Apparatus
For Refrigerating

MECHANICAL THERMOMETERS

HOHMANN & MAURER MFG. CO.
TRADE H&M MARK
ROCHESTER, N.Y.

For All Engineering and Manufacturing Purposes

Write for Illustrated Catalogue M.
NEW YORK 85 Chambers Street
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For Advancement in Practical Engineering
STUDY HAWKINS' AIDS
Standard & Up-to-date
$11. for a Set
$1. per Month
Catalog free for the asking.
Theo. Audel & Co. PUBLISHERS
63 Fifth Ave. New York.

MODERN WIRING

Our Flexible Steel Armored Conductors are endorsed by engineers for use in Marine or Ship Wiring, because of the high grade insulation, thorough protection from mechanical and other injuries, entire flexibility and low cost.

Send for descriptive bulletin No. 40,115. Send for catalogue 40,415.

SPRAGUE ELECTRIC COMPANY

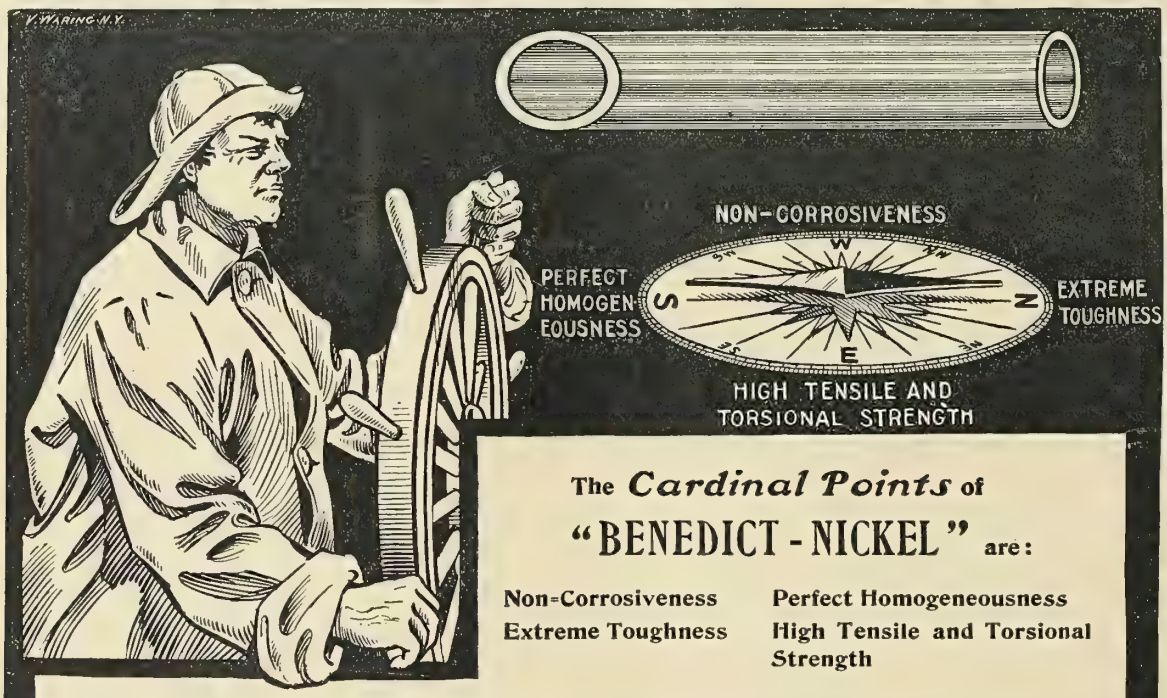
General Offices: 527-531 West 34th Street, New York.

BRANCH OFFICES: CHICAGO: Fisher Bldg. ST. LOUIS: Security Bldg. BOSTON: 176 Federal St. BALTIMORE: Maryland Trust Bldg.

NEW MARINE RAILWAY.—The H. I. Crandall & Son Company, East Boston, Mass., is just putting the finishing touches on a new marine railway in Jacob's shipyard at City Island, New York City. The cradle will be 165 feet long, and the railway has a capacity for hauling out vessels up to a thousand tons or more.

SIMPLEX ELECTRICAL COMPANY.—On March 18 there was much surprise all around in the plant of the Simplex Electrical Company, Cambridgeport, Mass. This was on account of a profit-sharing arrangement, of which the management had given notice some time before. There were 52 of the 350 employees who had $3,000 divided among them. The employees held a meeting and presented to the Messrs. Morss, the chief owners, a beautifully engrossed address of thanks, the address having been given by the mayor of the city. This business has grown in a very few years until now it has become one of the most important institutions in the country in the manufacture of insulated wire, electric heaters, etc.

LITHARGE PAINT.—The Litharge Paint Company, 103 East Lombard street, Baltimore, Md., is sending out a folder regarding this paint which states: Litharge paint is not a chemically treated paint. It contains no acids nor alkalies; is a perfect preservative for all metals; cannot be affected by smoke, soot or fumes of acids; can be applied to wood and walls when damp, and will perfectly dry them. Litharge paint will absorb rust, thus stopping all decay of metals. For ship work it cannot be excelled by the best paint in the market. It will stand as long as any other paint applied, will cover four to five hundred square feet to the gallon, is waterproof and spark-proof. Changes of climate cannot affect the paint because it is a perfect compact mass of cremated pigments, being mixed only with the best oils in the market. Litharge paint never gets fat or forms a skin, and will not settle in pots. It has a glossy finish, and is one of the best paints that can be put on wood. It will wear as long and as well on vessels as any other paint.



The *Cardinal Points* of

"BENEDICT-NICKEL" are:

Non-Corrosiveness — **Perfect Homogeneousness**

Extreme Toughness — **High Tensile and Torsional Strength**

These qualities make "Benedict-Nickel" peculiarly adapted for condenser tubes, and for every other purpose where highly non-corrosive tubing is required.

These are the best tubes for condensers ever devised. They positively resist electrolysis. They have steadily gained in favor with leading engineers and high naval authorities *because they do exactly what we claim for them.*

Their manufacture has long since passed the experimental stage. Their superiority over copper and brass tubes has been demonstrated by *actual use.*

The basis of the high non-corrosiveness of "Benedict-Nickel" is its inert nature, due to the combining of nickel with copper. The metal contains no zinc nor any other weakening metal. It is perfectly homogeneous.

The tubes are hot-rolled from solid cylindrical billets, not cast on a core, and given a twist formation like that of a gun barrel. Hence their great tensile and torsional strength.

We publish a "Treatise on Electrolysis of Condenser Tubes," which gives the full scientific reasons for the superiority of "Benedict-Nickel." Send for it.

We sell **Tobin Bronze** at manufacturers' prices.

BENEDICT & BURNHAM MFG. CO.,

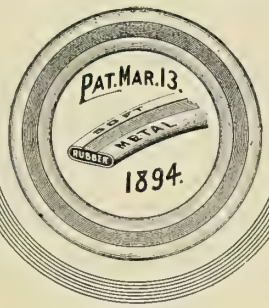
Mills and Main Office, Waterbury, Conn.

New York, 253 Broadway. **Boston, 172 High Street.**

THERE ARE MANY ASBESTOS PACKINGS

But only one brand having twenty threads woven to the inch. That brand is known as "Firefly" and sold only by

BESTOSKING PACKING & SUPPLY CO.,
170 Summer St., Boston
Agents for
TURNER BROS., ROCHDALE, ENGLAND



THE McKIM GASKET

Made of packing incased in soft annealed copper.
Guaranteed to stand 450 lbs. steam pressure.
Strength and elasticity perfect.
Can be reapplied indefinitely.
All sizes for manhole, handhole and pipe fittings.
Write for prices and catalog.

McCord & Co.

104 Broadway, New York
1471 Old Colony Bldg., Chicago

France Metallic Packing.—The superior qualities of France metallic packing have been demonstrated in the recent competitive tests with metallic packings of similar character manufactured by several concerns engaged in such industries. After a test it has been adopted by the Metropolitan Street Railway Company, New York, for eleven 7,000 horse-power engines; New York Gas and Electric Company, for eight 7,500 horse-power engines; Brooklyn Edison Company, for two 7,000 horse-power engines; Boston Elevated Railroad, for two 7,000 horse-power engines, and the New York Central and Hudson River Railroad for stationary work. It is also used in equipping the Manhattan engines in the large power-house in New York City, in addition to several other large contracts. A booklet on packing can be had by addressing A. W. France, Tacony, Philadelphia, Pa.

The Marck Steam Trap.—The sole agents for America for the well-known Marck steam trap are E. F. Houghton & Co., 240-250 West Somerset street, Philadelphia, Pa. This firm is sending out a mailing card in which it offers to install these traps on thirty days' trial, the traps to be returned at their expense if unsatisfactory. Regarding this trap this card contains the following claims: The Marck can be placed in any position, and occupies a very small space, therefore being desirable in marine work. When the Marck is used there is no possibility of freezing if set so as to drain. The Marck is absolutely automatic, and requires no valves except those which control the admission of steam to the apparatus to which the trap is attached. The Marck is regulated to work against any pressure between 1 and 200 pounds without readjustment. The Marck, being open at starting, cannot become air-bound, thus doing away with air-cocks, or vents.

A Big Order for Covering.—Probably the largest order for pipe covering ever placed has been secured by the H. W. Johns-Manville Company from the Pacific Coast Oil Company (which is practically the Standard Oil Company), who will lay about 280 miles of 8-inch pipe from Bakersfield to Point Richmond, on San Francisco Bay, to convey oil to the coast. As the grade is very slight, pumping stations are necessary along the line. On account of the heavy nature of the oil it must be heated to a certain temperature before it can be pumped, and to maintain the temperature of the oil in the pipes between the pumping stations a non-conducting covering is necessary, and the H. W. Johns-Manville Company, 100 William street, New York, is to supply the 280 miles of covering for this purpose, which, when ready for shipment to California, will fill 200 cars. The immense facilities of the H. W. Johns-Manville Company, at both the New York and Milwaukee factories, make it possible to successfully handle an order of this magnitude, and a number of miles of the covering were in transit to Bakersfield within a few days after the order was received.

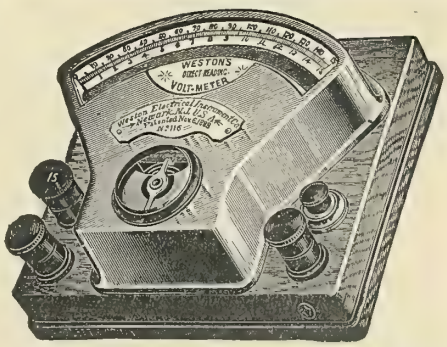
WESTON STANDARD PORTABLE DIRECT-READING

Voltmeters, Ammeters, Millivoltmeters, Voltammeters, Milliammeters, Ohmmeters, Portable Galvanometers, Ground Detectors and Circuit Testers.

Our Portable Instruments are recognized as **the standard** the world over. Our **Voltmeters** and **Ammeters** are unsurpassed in point of extreme accuracy and lowest consumption of energy.

WESTON ELECTRICAL INSTRUMENT CO.,
Waverly Park, Essex County, N. J., U. S. A.

BERLIN:—European Western Electrical Instrument Co., Ritterstrasse 88.
LONDON:—Elliott Bros., 101 St. Martin's Lane.



WESTON Standard Portable Direct Reading Voltmeter.

New Submarine Paint.—Mathew H. Devey, 1615 East Hewson street, Philadelphia, Pa., has had patented and is now getting ready to put on the market a new anti-fouling and preserving paint for ships, which is a combination of glass and other materials. He claims that it can be applied to hulls of either wood or steel as well as other submarine structures, and will prevent their fouling by barnacles and other sea growths. This paint is put on with trowels, and it gradually hardens, with a glassy surface. It is claimed that one coat of this is equal to six coats of ordinary paint. Another use for this compound is for interior purposes wherever it is desired to prevent rust and corrosion.

A Fine Catalogue Free.—Messrs. Charles H. Besly and Company, 10 North Canal street, Chicago, Ill., report their general business very good. They are making shipments of tools and supplies to all parts of the Union. They report numerous sales of their Gardiner grinders. Within the past month shipments of these well-known machines have been made to Oregon, Wisconsin, Connecticut, New York, and Massachusetts. They are receiving many orders for their celebrated Badger and Bonanza oil-cups, and are making liberal shipments of Helmet oil to all parts of the country. Their small tool business is very good indeed. Their 300-page illustrated catalogue will be mailed free to any address upon application.

Coaling at Sea.—The British Admiralty has recently made further experiments in coaling at sea with the marine cableway. H. M. S. *Trafalgar* has had a number of sea trials with the collier *Muriel* in coaling. A test took place while speeding at 11 knots and 35 tons per hour were transshipped. At one time in 33 minutes 21 tons were put across, which rate continued would have meant 40 tons per hour. The test took place in a half a gale of wind, which seemed to have no effect on the capacity of the machine. The course of the ships was frequently altered, making sharp turns to test the gear. All of such trials showed that the device has the ability to accommodate itself to any pull of the lines however sudden. The receiving gear was transferred to the *Empress of India,* and although the officers of this ship had no knowledge of the working of the device they were able to take 35 tons per hour. The British experiments go beyond the American experiments. The United States Navy coaled at 6 knots 20 tons per hour. The British have increased the towing speed to 11 knots, and doubled the capacity delivered to 40 tons per hour. Far more important is the installation now in hand by the United States Navy in equipping the U. S. S. *Illinois* with a Lidgerwood-Miller Marine Cableway, manufactured by the Lidgerwood Manufacturing Company, 96 Liberty street, New York.

Seaboard Steel Company.—A company has been organized in New York especially in the interests of shipbuilders and ship owners to operate a large forging plant within easy reach of New York City. For this purpose the Seaboard Steel Company has secured control of the plant well-known as that of the Whitestone Forge and Construction Company, Whitestone, L. I. This property consists of many acres of land and 550 feet of water front, deep enough to float almost any ship. This gives the best of water connection, and a spur from the Long Island Railroad enters the company's yard. Connected with the property is ample space for a 500-foot drydock. This plant was recently put into excellent condition and is equipped with much modern and up-to-date machinery. The new company intends to erect at once an open-hearth steel plant, with a capacity of 20 tons a day, so that it will not be dependent upon any other company for raw materials. The Seaboard Company starts out with a capital stock of $600,000, which it is proposed later to increase to $2,000,000. There are to be no bonds or other indebtedness. The Morton Trust Company, 38 Nassau street, New York, is the depository for the company. It is proposed to limit subscriptions as much as possible to vessel and iron men. Full information regarding the company can be had from Lloyd M. Scott, 11 Broadway, New York.

A $10 BARGAIN

We have on hand only a few sets of Marine Engineering, as follows:

1899, Vols. III–IV; 1900, Vol. V;
1901, Vol. VI;

bound in black cloth with leather corners and back.

The price for the set is $10.00.
The price per volume is **$4.50.**

Floor space in offices on Broadway costs so much that we shall not attempt to keep complete volumes or back numbers of the magazine any longer, and while the sets last we will sell them for **$10** complete, carriage to be paid by the purchaser. No reduction in price for single volumes.

The period 1899–1901 marks a turning point in the history of shipbuilding in this country, hence these volumes are of great historic as well as technical value.

MARINE ENGINEERING
309 Broadway, New York

SHIP AND MECHANICAL DRAFTSMEN WANTED.

A competitive examination will be held at the Navy Yard, League Island, Pa., May 2, 1902, for the purpose of establishing an eligible register of ship and mechanical draftsmen of the different grades. Pay of ship draftsmen from $5.04 to $3.60 per diem. Pay of mechanical draftsmen from $5.04 to $3.60 per diem. For application and further information apply to Commandant, Navy Yard, League Island, Pa.

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IT'S GUARANTEED

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104 Broad St., Boston, Mass.

The Northern Company's Steamships.—The Northern Steamship Company, which runs the two well-known steamships, *Northwest* and *Northland,* on the Great Lakes, has completely overhauled these ships during the past winter, spending over half a million dollars. On each boat is a duplicate generating set for electric lighting, the engines being furnished by the Buffalo Forge Company, and the generators by the General Electric Company. The ventilation of each ship has also been greatly improved, this work being in the charge of the Buffalo Forge Company, which has installed six Buffalo steel plate fans operated by electric motors on each steamship.

Brass and Copper Specialties.—The Waterbury Brass Company has moved into very large quarters at 122-130 Center street, New York. This is the main sales office of the company, and there is constantly carried in this warehouse a million pounds or so of brass and copper sheets, rods, wire, tubing, and other forms, so that orders of any size and for almost any class of goods can be filled promptly. This stock of goods includes almost anything that could be asked for for marine uses. It includes sheet brass in all the merchantable sizes, wire of all kinds, rods in great variety, not only of brass but of yellow metal, copper, Tobin bronze, etc., bolts of all sizes, brazed and seamless tubing, from the small size, such as are used for lubricating purposes, to the very largest sizes made. There is also everything in the line of copper which would be used in coppersmithing for marine purposes. This company issues a stock list which gives full information regarding all these specialties.

SPECIAL NOTICES.

Announcements under this heading will be inserted at the uniform rate of thirty-three-and-a third cents a line. Lines average ten words each.

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Energetic Salesman is wanted, to travel; one with sufficient experience to solicit orders for high-class forgings. Give age, experience, and references. Address,

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Cabin launch 36 1-2 feet long, 8-foot beam. The hull has 1 1-2 foot square oak frame, spaced 9 inches on centers, planked with cedar, copper and brass fastened throughout, not an iron nail, rivet or bolt in the whole construction. Cabin made from solid mahogany with 21 curved plate glass windows, inside of cabin paneled and moulded throughout. Saloon has ceiling veneered with mahogany, and is upholstered and cushioned with the best maroon car plush. Rear cock-pit upholstered in best quality leather. Plush carpet in saloon, a heavy cork linoleum in engine room and cock-pit. All windows handsomely curtained with silk and plush; all fittings polished brass; sideboard, refrigerator, clothes closet, and 3 large berths, invisible when not in use, with hair mattresses. Lavatory and closet, cook gallery and dish closet in engine room. Two cylinder gasoline engine made to order by one of the best makers, which has nickel fittings throughout. Engine also has a paneled mahogany cabinet which covers it entirely from view. All starting and oiling devices are operated from outside of the cabinet. Brass polished hand rail and standards running the entire length of the cabin roof. Planking on the hull is absolutely clear, neither knot nor plug, and does not leak a pailful in a whole season. There is not a thing about the boat that can be made better at any price. There is not a scratch, mar or dent anywhere on the boat, and it looks as well as the day it came out of the shop. There is no better or more seaworthy boat for its size; can be entirely closed in for rough weather, and by letting down the windows can be made practically an open boat. It will make about 10 miles an hour. There could be nothing said about this boat in praise that would misrepresent it in any way, and it will stand the closest inspection. The saloon is 10 feet long, engine room 8 feet, the lavatory and closets are entered from the engine room by sliding doors, large plate glass paneled doors between saloon and engine room, double panel doors from engine room to rear cock-pit; the roof covers the after cock-pit. The entire cabin, including cock-pit, is 24 feet long. After cock-pit and hatches are curtained water tight. It has fresh water tank of 40 gallons capacity connected by pump to lavatory, with best marine flush closets. Gasoline tank has 68 gallons capacity. All tanks are heavy copper. There are a great number of storage lockers, two anchors, several hundred feet of rope, flags, etc. A large roomy boat, and has carried 25 people; excellently fitted for cruising in fresh or salt water. For price address CABIN LAUNCH, care Marine Engineering.

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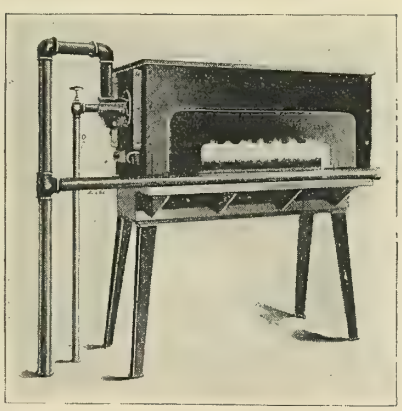

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The Peerless Spiral Piston and Valve Rod Packing

It will hold 400 lbs. of steam

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This packing is specially constructed for ice machine service, of layers of rubber and plies of duck which are so arranged and laid as to best resist the actions of ammonia, cold and heat.

The duck is a specially made duck, frictioned with an entirely new compound heretofore unknown to the rubber trade, and the core and back is of the celebrated Rainbow Packing compound, which is specially adapted to resist ammonia, cold and heat.

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This packing is made in several hundred sizes. The rings may be slipped onto the rod very readily.

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TRADE PUBLICATIONS.

Never-Stick is the name given by the Walworth Manufacturing Company, Boston, Mass., to its boiler blow-off valve. The valve is illustrated and described and dimensions given in an 8-page circular issued by this company.

Bulletin No. 301 describes the Lundell motors for driving ventilator fans and blowers. These motors are made by the Sprague Electric Company, 527 West 34th street, New York City. Various types of inclosed motors are illustrated.

Lundell Fans is the title of the handsome 24-page catalogue No. 304 issued by the Sprague Electric Company, 527 West 34th street, New York City. Desk fans, fans for placing on the wall or ceiling are illustrated. The motors are wired for either direct or alternating current. The latter part of the catalogue is devoted to price lists of the assembled machine and all the parts.

Noted Yachts and Their Lubricants is the title of a well-illustrated catalogue issued by the Vacuum Oil Company and Swan and Finch Company, 26 Broadway, New York City, manufacturers of marine lubricating oils, burning oils and greases. Among the vessels illustrated in the catalogue are the *Hohenzollern, Erin, Kanawha, Arrow, Niagara, Aphrodite*, etc., all of which use oils made by this company.

Printing on tracing cloth has often been attempted, but until recently no ink has been found that will give a clean print which will dry in a reasonable time and keep perfectly. A specially constructed press was also necessary. These complete outfits are manufactured by Golding and Company, 167 Fifth avenue, Chicago, Ill., and it is stated are giving much satisfaction to purchasers. Much valuable time of draftsmen and tracers is saved by using one of these presses for printing titles on drawings.

Cooling Towers is the title of a well-illustrated catalogue No. 1 issued by the Alberger Condensing Company, 95 Liberty street, New York City. The necessity of a cooling tower for cooling condensing water in large city plants where water has to be bought by meter, and in other factories where water is used for cooling purposes, is generally well recognized among engineers. The system which has been developed by the Alberger Company will recommend itself to those acquainted with this subject. Copies of this catalogue may be had by writing to the company and mentioning MARINE ENGINEERING.

Marine boilers of every type are illustrated and described in the pocket-size catalogue issued by the Kingsford Foundry and Machine Works, Oswego, N. Y. This company makes Scotch boilers with one, two and three furnaces, the improved Redfield marine boiler, the two-furnace Blake marine boiler, the two-furnace compact and the elipse marine boilers. These boilers are installed on many vessels. In connection with the new modern boiler plant of this company, there is an extensive machine shop and foundry for turning out marine engines of various styles. A copy of this and the large catalogue published by the Kingsford Works will be sent upon application.

Oil fuel is replacing coal in some departments of mechanic arts. The various uses for which this fuel may be applied is illustrated in the large Catalogue C issued by the Rockwell Engineering Company, 26 Cortlandt street, New York, under the title of "Furnaces." This company builds furnaces for every purpose; for annealing, for brass and copper, scrap metal, for rivet heating, hardening, wire baking, copper wire brazing, cloth singeing, and, in fact, every purpose for which a furnace is required. In all of these furnaces, this company's system of oil feed is used. The equipment of marine boilers with oil burners is at present being undertaken to a large extent by this company, and the boilers of several ships have been equipped with the Rockwell system of oil fuel supply.

When writing to advertisers please refer to MARINE ENGINEERING.

The Newport Engineering Works, Newport, R. I., has established a well-equipped machine shop in that city for general repair work on yachts, launches and automobiles. The various departments of this business are described in the catalogue issues by the company.

The direct current generators of the single field coil type manufactured by the Sprague Electric Company, 527 West 34th street, New York City, will be found thoroughly illustrated and described in Bulletin 101, which is now being distributed. The bulletin contains many large illustrations, including those of marine lighting sets.

An illustrated catalogue of pumps has just been published by Rumsey and Company, Ltd., Seneca Falls, N. Y. This catalogue is the fifty-third edition and embraces all kinds of hand and power pumps for every class of work from house and farm service to rotary centrifugal pumps for fire and power service. One compact style of pump made by this company is the triplex pump, in which the triple pump is driven through a series of gearing by an electrical motor. Steam and power driven pumps are also described.

Marine Apparatus, manufactured by the Holtzer-Cabot Electric Company, Brookline, Mass., is illustrated in Bulletin No. 133, just issued. A description is given of launch motors, switches, generating sets, igniters, etc. Igniters for gas engines have in the past given much trouble to the owners of launches propelled by gas engines. The Holtzer-Cabot Company describes its type of igniter and illustrates the proper method of wiring this instrument to batteries and the cylinder of an engine in Bulletin No. 1366 recently issued.

Crane Company's extensive line of valves, cocks and steam fittings of every assortment are described in detail in the 1902 book catalogue just issued by this company. The Crane Company, established in 1855 in Chicago, has branch offices in fourteen cities throughout the United States. The valves are well illustrated in this catalogue and the various sizes given in accompanying tables. Pipe fittings of cast and malleable iron and brass are also presented. Then follows a complete illustrated list of engine and boiler trimmings, steam packing, engineers' tools, etc. We presume that steam users may secure copies of this catalogue by writing to the company and mentioning MARINE ENGINEERING.

A block and truck catalogue, which has probably never been equaled in completeness and excellence, has been published by the Boston and Lockport Block Company, 160 Commercial street, Boston, Mass. It is bound in heavy board and comprises 136 pages. In addition to the regular line of blocks, trucks and other specialties of this company, it has a number of new features, including bushings, bronze yacht blocks, Tarbox metal snatch blocks and several other kinds of blocks for Manila and wire robe, Loud's nonchokable pumps, mallets, wharf and deck trucks of great variety, etc. A copy of this catalogue should be in every ship and yacht building establishment, as well as in the hands of anybody who has to do with the purchasing of blocks.

Pawling & Harnischfeger, Milwaukee, Wis., have issued Bulletin No. 7 in which are given many illustrations of the various kinds of electric traveling hoists which they manufacture. These hoists which are operated by electricity are used for hoisting material from one part of a warehouse or shop and transport it to any other part by means of an overhead runway. This runway consists of an I beam track which may be inexpensively built throughout a series of shops between whatever points the material is to be transported. Traveling electric hoists are a recent feature in the application of electricity, but there are enough of them in successful service to prevent them from being considered as experiments. Among the users of this make of electric hoists are many of the most prominent shops of the country, including the New York Ship Building Company.

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TRY SQUARES

GET THE BEST

They cost but little more and they can always be depended upon to be accurate if they are **Starrett** make.

No. 21 squares are of thin, polished steel, and lie flat on the work. Draughtsmen as well as machinists use them. Made in 2, 3, 4 and 6 in. sizes. Several other styles of Try Squares are shown in

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The L. S. Starrett Company
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Ship's Deck, Bilge, Triplex Power

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HAND AND POWER PUMPS
for all purposes.
Send for Catalogue.

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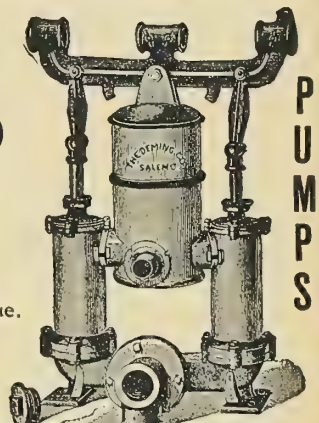
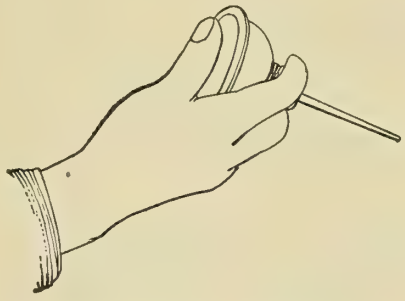


A three part catalogue of high artistic value has been issued by the Gas Engine and Power Company and Chas. L. Seabury and Company, Consolidated. The office and works are at Morris Heights, New York, and the downtown office is at 11 Broadway, New York City. In the first edition are illustrated steam yachts, launches and marine machinery, with handsome cuts of several of the famous steam yachts built by this company and cabin and deck views of them. The second division is profusely illustrated with views of the various classes of vessels at Morris Heights, viz.: steam yachts, torpedo boats, sailing yachts, cutters, tugboats, lighters, houseboats, etc. Naphtha launches and engines are handsomely illustrated in the third section. Here will be found cabin plans and views of naphtha launches of large and small sizes. To those interested in pleasure craft and small boats this very handsome catalogue will prove of great interest. Copies of it may be had upon application.



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You can use is

DIXON'S

Pure Flake

GRAPHITE

in an ordinary

SQUIRT CAN.

For valves and cylinders and all bearings there is nothing to equal Dixon's graphite. Sample free.

JOSEPH DIXON CRUCIBLE CO., JERSEY CITY, N. J.

Some large tools built by the Niles-Bement-Pond Company, 136 Liberty street, New York City, are handsomely illustrated and briefly described in the 24-page, pocket size circular issued by this company. The line illustrated covers the machines required in the equipment of a shipyard. The company states that it will be pleased to distribute this catalogue and give any information to those interested.

The Milwaukee Automobile Book is the title of a handsome 36-page book of automobile information issued by the Milwaukee Automobile Company, 19th street and St. Paul avenue, Milwaukee, Wis. The book is written to answer all sorts of automobile questions and treats of the automobile under the headings of "Sport of Kings," "Practical Side," "Is the Steam Machine Best?" and the "Milwaukee." The several styles of steam carriage made by this company are handsomely illustrated. This company also make a steam plant for launches.

How to Make a Tight Joint is told concisely in a neatly published booklet issued by the Merwarth Metallic Gasket Company, 120 Liberty street, New York City. Every user of steam will read this with much interest.

Acetylene Search Lights for vessels of all sizes and docks are treated in a leaflet issued by the American Acetylene Stove Company, 504 Masonic Temple, Minneapolis, Minn. This form of light is daily growing in popularity because of its intensity whereby the size and weight of the lamp may be greatly reduced.

The Davidson steam pump is handsomely illustrated and described in detail in a new 80-page catalogue just issued by M. T. Davidson, 43 Keap street, Brooklyn, New York. Pressure and boiler pumps, for medium and heavy service, circulating pumps, vertical cylinder pumps, which are especially adapted for marine purposes, compound pumps, twin cylinder marine air pumps, ash ejectors, etc., are well illustrated and described. The last pages of the catalogue are devoted to tables with general information for engineers. This catalogue can be had upon application by mentioning MARINE ENGINEERING.

The Hydro-Carbon system is described in an illustrated catalogue issued by the Steam Boiler Equipment Company, 20 West Houston street, New York. By the application of this system of induced draft to boilers, it is stated that the smoke nuisance has been prevented, the power increased and fuel saved. The system has been installed on both fire and water tube boilers, burning anthracite or butuminous coal, and can be readily equipped without change of fire chamber or setting. Several stationary plants, and the boilers of some large vessels, including the steam yacht *Niagara,* have the hydro-carbon system installed and the users have written strong letters of commendation. These points are covered in the catalogue.

Catalogue No. 5, 1902, issued by the Cleveland Punch and Shear Works Company, 156 Case avenue, Cleveland, Ohio, is one of the handsomest products of the printer's art that has come to our notice. It comprises 118 pages of illustrations and descriptions of the many styles of punches made by this company. The first pages are devoted to illustrating the detail of the jaws of the punches, and then follow cuts of single punches of many forms and styles. The double punch and shares made by this company, built with throats from 12 inches to 60 inches, are illustrated. Then follow horizontal punches, bending and straightening machines, malleable punches or gauge shears, bar shears, alligator shears, angle shears, splitting and bevel shears. Bending rolls from sizes driven by hand to the heaviest ones used in bending heavy plates are next taken up. Then are described angle bending rools, metal saws and plate planers of various types. Among these should be mentioned a rotary planer motor-driven, built in sizes up to 60 inches head, 24 feet bed and 20 feet cutting travel. The last pages are devoted to radial drills, hand spindle drills and other special heavy machines.

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Specialty of **BRASS VALVES** and Fittings for Marine Construction

Extra Heavy Valves, Bent Pipe and Fittings for High Pressure Work

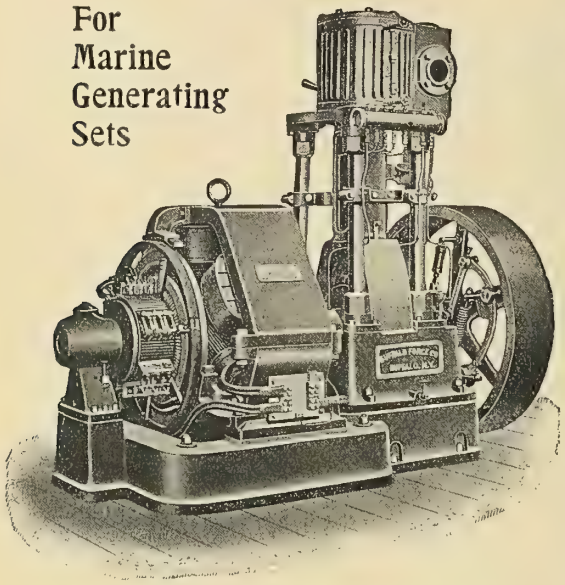
SOLE MANUFACTURERS OF **WALWORTH FLANGED—OVER PIPE JOINT**

Which does not Weep under heavy pressure

OUR BOOK CONTAINING "TABLES OF DIMENSIONS" OF WALWORTH GATE VALVES, FLANGED FITTINGS, FLANGED OVER PIPE JOINTS, WROUGHT IRON BENDS, ETC., should be in your draughting room.

Buffalo Marine Engines

For Marine Generating Sets



Buffalo Forge Company,

BUFFALO, N. Y.

NEW YORK OFFICE, 39 Cortlandt Street

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Whether salt or fresh, tries paint more severely than the other elements; therefore ship builders use

ZINC WHITE

exclusively when white paint or tints are required for finishing their products. Marine work demands zinc white, because it is the only white pigment that will stand the service.

FREE : Our Practical Pamphlets
"The Paint Question"
"Paints in Architecture"

THE NEW JERSEY ZINC CO.
11 Broadway
New York

Every pattern maker and wood worker realizes the value of the quick acting vise. The patent quick-acting vises manufactured by Wyman & Gordon, Worcester, Mass., are illustrated in a leaflet published by the manufacturers.

A short story of Robert Fulton is published in a leaflet distributed by Wyman and Gordon, Worcester, Mass., manufacturers of forgings. A sketch is given of his interesting life and the question as to whether or not he was the inventor of the steamboat is touched upon.

The Aero-Painter, which is made by the Patton Paint Company, Milwaukee, Wis., is illustrated in a neat folder. This machine is claimed to be one of the first practical painting and whitewashing machines that has been made. It is equally adapted for exterior and interior painting. A pump placed in a pail of paint or whitewash sprays the liquid through holes over the surface to be coated.

Users of steam hammers will find what is probably the most complete catalogue on the subject ever issued in the one being distributed by Bement, Miles and Company, Philadelphia, Pa. It comprises 76 pages and is neatly bound in a cover printed in three colors, inculding a striking picture of a hammer in operation. The text is printed on heavy coated paper. The pages are 6 by 9 inches in size and a great many of the illustrations are full-page size. Almost every conceivable thing in the line of hammers is shown.

The Buffalo Forge Company, Buffalo, N. Y., manufacturers of the famous Buffalo forges, has just issued its new catalogue for distribution among the trade. It is a handy little book, pocket size, illustrated with half-tone engravings throughout, describing in detail not only the many different types and sizes of forges but includes a description of the Buffalo hand blower, power and hand drills, shears, bar cutters, etc. This handsome copy will be mailed to inquiring parties who mention MARINE ENGINEERING.

A unique invitation to "drop in" is sent to all inquirers by the Garvin Machine Company, Spring and Varick streets, New York City. Just how this is to be done and why is told in the invitation.

Hack-saw frames are well illustrated and described in a leaflet issued by the Union Hardware Company, Torrington, Conn. These instruments are required in every machine shop afloat and ashore. This company also makes a copper tipped hammer, the head of which is made of malleable iron into which the copper tips are fitted and held in position by a set screw.

The subject of force-feed lubrication is most excellently handled in a catalogue which is now being distributed by the Force Feed Lubricating Company, Milwaukee, Wis. The catalogue is very neatly printed in two colors and there are a large number of illustrations of this company's lubricators. It is stated on the face of the catalogue that a three months' trial is given free to any one who wishes to give one of these lubricators a test.

Direct Current Motors and Small Generators is the title of Bulletin 55 being distributed by the Rochester Electric Motor Company, Rochester, N. Y. It is neatly printed in two colors, and, among other features, has a neat picture of one of this company's dynamos direct connected to an Acme engine, making a small direct connected plant especially designed for yacht and other uses where a plant of small lighting capacity and compactness is desired.

The Telephone in an Electric Push Button is the terse description of the office telephone system controlled by the American Push Buttton Telephone Company, 463 Fifth avenue, New York City. The instrument is not much larger than the ordinary push button and contains a transmitter and receiver and a switchboard for connecting the various stations. This system has also been successfully used for communicating over long distances, a conversation having been carried on over these instruments from London to Paris.

The use of fuel oil is handled in an instructive manner in a booklet issued by the National Oil Burner and Equipment Company, Carleton Building, St. Louis, Mo. A special feature of this system as shown in the booklet is that the oil is fed to the furnaces automatically.

Keystone Hair Insulator is one of the products of the H. W. Johns-Manville Company, 100 William street, New York City, manufactured especially for refrigeration and cold storage use. A 20-page booklet is now being distributed by the company, giving a great deal of information regarding this insulation.

Launch owners and those of our readers interested in them will receive upon application a number of slips giving pictures and information regarding the launches manufactured by the Bridgeport Machine and Motor Company, Bridgeport, Conn., which has opend a much larger establishment at 91-111 Kossuth street.

Engineers and draftsmen who are contemplating buying drawing instruments and materials will do well to send for the catalogue issued by Schwencke, Kirk and Company, 26 Liberty street, New York City. In it will be found illustrations and price lists of the extensive line of domestic and imported goods carried by this company.

From a pair of pipe tongs to the finest of pipe threading machines driven by electric power, D. Saunders Sons, Yonkers, N. Y., make a great variety of tools for gas fitters and steam fitters. The firm's new illustrated catalogue contains many views and many pages of well-arranged descriptive matter. All the recent improvements in this line of machinery are carefully shown.

The air compressors, made by the Chicago Pneumatic Tool Company, Fisher Building, Chicago, Ill., are illustrated in a special Circular No. 22. Compressed air is rapidly superseding other forms of power in outside shipyard work, and the compressors here illustrated are well adapted for this service. This circular, and also a catalogue which is published by this company, will be sent upon request to those mentioning MARINE ENGINEERING.

Ventilators manufactured by the Buffalo Forge Company, Buffalo, N. Y., are illustrated in a new 16-page catalogue issued by this company describing in detail many different types and sizes of ventilators. The ventilators are built of heavy gauge iron and fulfil the somewhat hard requirements for convenient and desirable apparatus. The company has had a quarter of a century's experience of heating and ventilating buildings and ships.

The Garvin Machine Company, Spring and Varick streets, New York City, has published an attractive catalogue No. 2 concerning plain milling machines. The various styles and details of machines manufactured by this company are illustrated and described and dimensions given. The company invites all those interested in machine tools to inspect its large showroom and will be very glad to distribute catalogues and impart any further information concerning machines to those interested.

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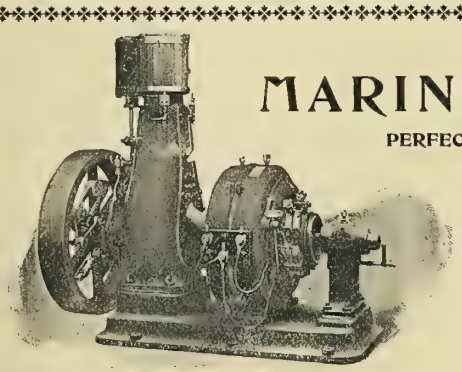
The enclosed arc lamps for alternating current manufactured by the Fort Wayne Electric Works, Fort Wayne, Ind., will be found fully described in Bulletin No. 1,023. Copies can be had upon application.

The several steam specialties manufactured by the American Steam Gauge and Valve Manufacturing Company, Boston, Mass., are unusually well illustrated and equally well described in a 12-page neatly published catalogue which is now being distributed. The several specialties, including pop safety valves of every type and gauges of all kinds.

Terse Tank Talks are given by S. F. Bowser & Company, Fort Wayne, Ind., in a 24-page booklet which is being distributed. The many varieties of oil tanks manufactured by this company are illustrated and there is a good deal of information regarding the care and economical use of lubricating and other oils which will be of much interest to our readers.

Alco-vapor Launches made by the Marine Engine and Machine Company, Harrison, N. J., are handsomely illustrated in the new catalogue issued by this company, which builds the hulls and engines for launches from the smallest size of yacht tenders to large cruising launches. The alco-vapor motor is entirely distinct from other marine motors in that wood alcohol vapor is used as the medium of transmitting power. This system is described in the catalogue.



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BUSINESS NOTES.

PHILADELPHIA PNEUMATIC TOOLS.—The new plant which the Philadelphia Pneumatic Tool Company has been completing at 21st street and Allegheny avenue, Philadelphia, Pa., is now completed and the company is installed in its new location. Only recently orders were placed for $10,000 worth of new machine tools, and most of these are now delivered, so that the company has ample facilities for giving prompt attention to orders for pneumatic chipping, calking and riveting hammers and other specialties. About 150 men will be employed in the new factory. The company is now placing on the market two new sizes of rotary drills, and it has perfected an improved riveting hammer which is being made in three sizes having capacities for from one-quarter of an inch to an inch and a quarter rivets. An order has just been received from one of the largest ship yards in the country for over 200 tools.

INCREASE OF BUSINESS.—To meet the demand of increasing business the Merwarth Metallic Gasket Company has removed from 107 Liberty street into larger quarters in the Beard Building at 120 Liberty street, New York City.

TECHNOLOGY IN CORRESPONDENCE SCHOOLS.—The managements of the American School of Correspondence, Boston, Mass., and the Armour Institute of Technology, Chicago, Ill., announce that they will co-operate in providing technical education by correspondence along the lines of, and in harmony with, the best laboratory and residence school methods. The faculties of the two schools are closely associated and the students in one school will be given credit for work in the other when desired. Dr. Frank W. Gunsaulus, president of the Armour Institute of Technology, is also the head of the Advisory Board of the American School. The correspondence school is doing a work which brings a better appreciation of the value of higher education to the masses.

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A PRESENT TO EVERY ONE WHO WRITES.—A handsome match box will be sent free to chief engineers and steamship owners who are interested in high grade metallic packing by A. W. France, Tacony, Philadelphia, Pa. Mr. France will also send a copy of his catalogue illustrating and describing his complete line of packings upon request. Inquirers are requested to mention MARINE ENGINEERING when writing.

WELDING FURNACE.—The oil welding furnace made by W. M. Simpson and Company, Old Colony Building, Chicago, Ill., is performing the most exacting work in this line. A large forging company which has forty of these machines in continual operation states that, although the class of work handled by the machines is of the most difficult character, they are able to rapidly turn out work with the welds that can neither be seen nor broken.

ELECTRIC KITCHEN EQUIPMENTS.—The Simplex Electrical Company, Cambridgeport, Mass., has placed on the market a complete line of electrical stove equipments. This includes ovens and stoves with attachments for connecting to an electrical circuit. The advantage of this system of cooking, whereby heat is used only when required and in the most economical manner, will be especially appreciated by the owners of electric launches, and smaller yachts where an electric plant is installed.

MARINE PAINTS.—George N. Gardiner & Son, 53 South street, New York City, inform us that the torpedo boat destroyer *Bainbridge* was recently given a semi-official trial trip and that the best speed she could make was 27 knots per hour. She was drydocked and coated by this firm with American-McInnes compositions and on her next trial trip made 28.6 knots per hour. They claim that this increase of speed of over a knot is directly due to the superior smooth and slippery surface which the McInnes coatings present to the action of the water, because the friction is reduced to a medium when the vessel is in motion. Another most important claim made for these compositions is that they protect the metal to a greater extent than many other coatings. The ferryboat *Newtown*, of the Nassau Ferry Company, which has been coated with this composition ever since she was built twenty-three years ago, was recently drydocked, and the superintendent of the ferry line, scraped down through the thick skin of the paint to the bare iron and reported that he found it in exactly the same condition as when the boat was first built; there had been no deterioration, no rust, and no pitting, and he declared that in his opinion the metal had never been wet, the American McInnes compositions forming a water-proof coating, and preventing all action of any kind. The Messrs. Gardiner have had similar experiences on two of the oldest ships of the Ward Line, and other steamers which have been coated for a great many years. These coatings are also very extensively used by the Navy Department.

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BERLIN:—European Western Electrical Instrument Co., Ritterstrasse 88.
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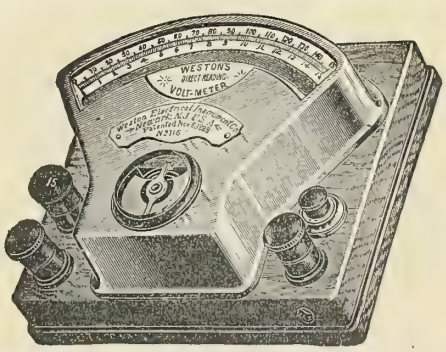

WESTON Standard Portable Direct Reading Voltmeter.

PRESSURE REGULATIONS.—The Foster Engineering Company, Newark, N. J., has furnished its combustion valve for nearly all the U. S. torpedo boats and destroyers. The pressure regulator, class W, built by this company will be used on the monitor *Cleveland* and cruisers *Florida* and *Des Moines*.

MODERN MARINE WORK.—The Marine Iron Works, Chicago, Ill., have recently completed or have under construction the following contracts: A large amount of machinery for the Tabasco-Chiapas Trading and Transportation Company; a stern wheel steamboat for the Zaragoza Mining Company, U. S. of Colombia; a pair of 9 by 36 inch stern wheel engines for Central America; a set of 12 24 by 72 inch horizontal, tandem, compound, condensing, stern wheel marine engines; a river steamer for Mexico; an 80-foot yacht for the St. Lawrence River, and several other orders for Europe and South America.

FALLS HOLLOW STAYBOLTS.—The Falls hollow staybolts manufactured by the Falls Hollow Staybolt Company, Cuyahoga Falls, Ohio, have been recently tested by the McGill University, Montreal, Canada. The tests show that the double refined charcoal staybolt iron which is used is of superior quality. The length of the specimen was 25⅜ inches, the mean outside diameter, 1.014 inch; the yielding point, 32,000 pounds per square inch; the ultimate tensile strength, 49,300 pounds; equivalent elongation in 8 inches, 31.2 per cent.; reduction of area, 45.7 per cent. The advantages of the hollow staybolt are being rapidly acknowledged by the marine boiler manufacturers. It not only adds to the combustion of fuel, but it has a double advantage for the detection of breakages should any occur; again, the strength is always uniform throughout the entire length of the bolt, no one point being weaker than another. Most of the users of this staybolt have the hole open next to the fire as well as the outer end, claiming that there is just enough air admitted through the sixteenth of an inch hole through the bolts to greatly aid the combustion of the fuel. This company also manufactures solid staybolt iron for those that prefer it.

SUPERINTENDENT OF PERTH AMBOY SHIP YARD.—Mr. Chas. Schofield, who has had extensive experience in the shipyards on both sides of the Atlantic, has taken the position of superintendent at the Perth Amboy Shipbuilding and Engineering Company, Perth Amboy, N. J. Mr. Schofield comes from a shipbuilding family. He was first apprenticed with the Earl Shipbuilding and Engineering Company, Hull, England, attending at the same time a course in an evening technical college. Completing his apprenticeship, he visited various yards in Scotland, and in 1880 came out to this country first working at the Detroit Dry Dock Company's Wyandotte (Mich.) yard, then with the King Bridge Company, of Cleveland, and next with F. W. Wheeler, of West Bay City, Mich. In these several positions he laid out and superintended work on many of the large ships building at that time on the Great Lakes. In 1891, Mr. Schofield became superintendent for the Bath Iron Works, and in later years he has been with the Harlan and Hollingsworth Company, William Cramp and Sons Ship and Engine Building Company and the Eastern Ship Building Company, in all of which companies he has been connected with the laying out of large work.

LAKE SERVICE RESUMED.—The Cleveland and Buffalo Transit Company, Cleveland, Ohio, announces that the service between Buffalo and Cleveland has been opened for the season by the steamers of this company. The boats leave Cleveland daily at 8 p. m.

NEW BRANCH OFFICES.—The Lozier Motor Company, Plattsburg, N. Y., announces that branch offices have been opened at No. 1 Broadway, New York City, and No. 20 Central street, Boston, Mass. A Lozier launch for demonstrating the applicability of the Lozier engines will be in service at one or more convenient localities at each of these cities and prospective purchasers will be given every opportunity to become acquainted with the workings of the launches.

The modern steam vessel contains such a mass of machinery that Professor Durand in his book, "Practical Marine Engineering," has devoted a chapter to the subject of

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Ash Ejectors,
General Arrangement of Machinery.

THE CHAPTER ON REFRIGERATION

has the following contents:

General Principles,
Refrigeration by Freezing Mixtures,
Refrigeration by Vaporization and Expansion,
Principal Features of Ammonia Refrigerating Apparatus,
Refrigeration by the Expansion of a Compressed Gas,
Principal Features of Compressed Air Refrigerating Apparatus,
Operation and Care of Refrigerating Machinery.

THE CHAPTER ON ELECTRICITY

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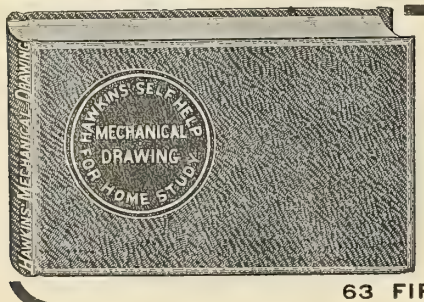

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D. & C. NAVIGATION COMPANY.—The Detroit and Cleveland Navigation Company announces that service between Cleveland, Detroit, Toledo and Mackinac has been resumed for the summer season of 1902. This company has published a very handsome 64-page folder describing and giving pictures of the fine new ships of the several lines and scenes along the shores of the lake.

CRANE'S NEW DRY DOCK.—Theodore A. Crane's Sons' new sectional drydock, composed of four sections, each 90 feet long and 60 feet wide, was recently placed in commission at the Erie Basin, Brooklyn, N. Y. It is located at the owners' shipyard in the angle of the breakwater. There are sixteen 14-inch pumps in each section, or sixty-four on a side, making 128 in all, which are capable of clearing the dock of water in twenty minutes.

ENLARGED OFFICES.—The Sprague Electric Company has found it necessary to move its Boston office into new and larger quarters to enable it to handle the increasing business in the New England district. The company has taken a suite of offices in the Weld Building, which is one of the most desirable office buildings in Boston. Mr. F. C. Farnsworth continues as manager of the Boston office and has recently added to his staff Mr. Geo. D. Simmons.

PERTH AMBOY SHIP YARD.—The Perth Amboy Ship Building and Engineering Company announces that, having acquired the plant and adjoining property of the late Hugh Ramsey at Perth Amboy, N. J., it is prepared to conduct a general ship building business, including the building and repairing of steel and iron vessels of all descriptions, the manufacture of marine engines, gasoline and kerosene engines, marine and stationary boilers, both water tube and cylindrical, and the building and installation of all classes of machinery. The New York office of the company is 90 Wall street.

WESTINGHOUSE STEAM TURBINES.—The Metropolitan Railway Company, of London, has contracted with the British Westinghouse Electric and Manufacturing Company, of Manchester, England, for Westinghouse steam turbines for the electric generating station about to be built for the former company. The Westinghouse Company is now filling a similar contract for the Metropolitan District Electric Traction Company, and, as there will be a general similarity in the two stations it will be easy to arrange for connecting the two and making them interchangeable as far as the supply of current is concerned. The Metropolitan power station will contain three sets of 3,500 kilowatts capacity each. The Chelsea station of the Metropolitan District Railway will contain four sets of 5,000 kilowatts each. The electrical machinery for both stations will also be supplied by the Westinghouse Company.

BUFFALO FORGE WORKS.—Among the many contracts recently awarded to the Buffalo Forge Company, Buffalo, N. Y., may be mentioned the equipment of the Pennsylvania Steel Company's forge shop with twenty Buffalo down-draft forges by means of which all smoke and gases are immediately and completely exhausted. This company has contracted with the Lake Shore and Michigan Southern Railroad for heating and ventilating the wood working mill and freight shops at Collingwood, Ohio. The Bowery Bay Building and Improvement Company, New York City, will be furnished with a 200 H. P. horizontal center crank engine for an electric lighting plant. This engine is of the same type as the one exhibited by the Buffalo Forge Company at the Omaha Exposition in 1898, which was bought by the Improvement Company. An order has also been placed with the Seaboard Realty Company, New York City, for six 120 H. P. engines and two 95 H. P. engines for an electric light plant.

SPECIAL NOTICES.

Announcements under this heading will be inserted at the uniform rate of thirty-three-and-a-third cents a line. Lines average ten words each.

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An outside position of a supervising nature in a moderate size shipyard wanted by a young shipbuilder with both yard and drafting office experience. Reply to "A. B. C.," care MARINE ENGINEERING.

MARITIME ASSOCIATION.—An organization meeting of the Board of Directors of the Maritime Association of the Port of New York as newly constituted, was recently held. Among the members for the standing committees for the ensuing years are: Messrs. Wallace Downey, Gustave A. Schwab and William P. Clyde.

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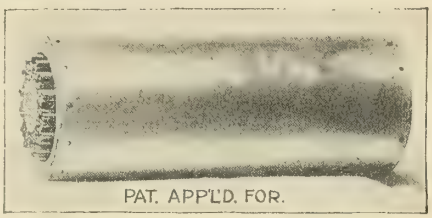

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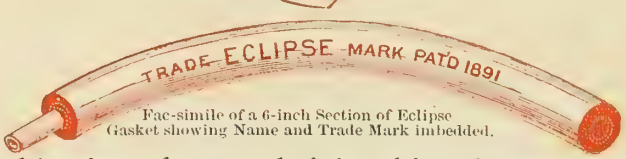

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" 5, Otto Boettger, 1035 E. Hopkins Ave., Baltimore, Md.
" 6, Clifford E. Shrodes, Room 13, Railroad Exchange, 110 North Fourth St., St. Louis, Mo.
" 7, B. J. Holmes, 191 Coyle St., Portland, Me.
" 9, Wm. Bridges, 784 1-2 12th St., Milwaukee, Wis.
" 13, Wm. V. H. Sheer, 1129 Venango St., Philadelphia, Pa.
" 15, C. J. Lewis, 320 Deloronde St., New Orleans, La.
" 17, Francis S. Neal, care Mt. Auburn Cable Road, Cincinnati, O.
" 18, Wm. Hurst, 715 Walnut St., Cairo, Ill.
" 20, Jos. B. Barry, 206 Keel St., Memphis, Tenn.
" 23, W. R. Lewis, 213 East Front St., Jeffersonville, Ind.
" 24, Jos. B. Flach, 327 N. Fourth St., Paducah, Ky.
" 26, T. H. Kirkbride, 910 East Columbia St., Evansville, Ind.
" 27, N. P. Slater, 1010 Garfield Ave., Bay City, Mich.
" 30, John W. Farrow, 816 Rebecca St., Allegheny, Pa.
" 33, W. J. Du Bois, Tompkinsville, S. I., New York.
" 35, Wm. Warin, 36 East St., San Francisco, Cal.
" 36, Joseph Thomas, 57 Sea St., New Haven, Conn.
" 37, J. A. Page, 1743 Huron St., Toledo, O.
" 38, W. H. Collier, 73 Starr Boyd Building, Seattle, Wash.
" 39, Frank W. Buchner, 124 Chestnut St., Erie, Pa.
" 40, S. P. Mallia, 1028 Market St., Galveston, Tex.
" 41, J. W. Collyer, Goble, Columbia Co., Ore.
" 42, Hy. J. Sloan, 810 Spearing St, Jacksonville, Fla.
" 43, Thos. J. Coyle, 627 Superior St., Port Huron, Mich.
" 44, George Layman, 274 Third Ave., Manistee, Mich.
" 45, Jas. A. Rourke, 708 East Bay St., Savannah, Ga.
" 46, D. W. Farrell, Clayton, N. Y.
" 47, Norman Raines, 804 East Spruce St., Sault Ste. Marie, Mich.
" 48, Carl V. Hart, 425 Perry St., Sandusky, O.
" 51, Henry Connell, 28 Yuba St., Muskegon, Mich.
" 53, Harry Stone, Marine City, Mich.
" 55, Archie Stalker, Electric Light & Power Plant, Cheboygan, Mich.
" 57, E. B. Meeker, 71 Abeel St., Kingston, N. Y.
" 58, E. Capers Haselden, P. O. Box 31, Georgetown, S. C.
" 59, Daniel L. Kemp, Box 36, East Boston, Mass.
" 62, Nathan S. Lawrence, 30 Connecticut Ave., New London, Conn.
" 65, Wm. McCarrel, 8 Vernon St., Charleston, S. C.
" 67, Wm. S. Bradley, Saugatuck, Mich.
" 70, Frank H. Goodell, 536 1-2 Commercial St., Astoria, Ore.
" 72, Thomas Navagh, 40 Lake St., Oswego, N. Y.
" 73, Louis Garot, Box 1526, Green Bay, Wis.
" 76, Orson Vanderhoef, Grand Haven, Mich.
" 77, Jos. P. Brewer, 206 N. Ninth St., Manitowoc, Wis.
" 78, F. A. Rehder, 29 W. Superior St., Duluth, Minn.
" 80, R. P. Cook, 46 Elm St., Albany, N. Y.
" 81, Jas. L. Sweeney, 204 E. Saragossa St., Pensacola, Fla.
" 82, Fred H. Gowell, 427 Middle St., Bath, Me.
" 84, Joseph F. Dumas, 403 Dauphin St., Mobile, Ala.
" 85, G. H. Miller, 412 Fifth St., Alpena, Mich.
" 86, Sherman A. Smith, 737 Menekannee Ave., Marinette, Wis.
" 87, Geo. B. Milne, 1003 Trumbull St., Detroit, Mich.
" 88, C. O. Chapman, S. B. Canal, Sturgeon Bay, Wis.
" 89, Robert Vallance, 69 Morris St., Ogdensburg, N. Y.
" 91, Robert Davidson, 17 Fairfield Ave., Harbor Sta., Ashtabula, O.
" 92, H. E. McArthur, Courier-Herald Bldg., 3d floor, Saginaw, W. S., Mich.
" 93, M. E. Davis, M. T. & S. Co., 929 D St., N. W., Washington, D. C.
" 94, George R. Jones, Box 222, Washington, D. C.
" 95, A. P. Jerguson, Box 198, Key West, Fla.
" 100, Jas. P. Lynch, Honolulu, H. I.
" 101, Thos. J. Hanlon, Box 765, Norfolk, Va.
" 102, Fred W. Linsemeyer, 210 Clinton St., So. Haven, Mich.
" 103, C. H. Hall, Box 512, New Berne, N. C.

TRADE PUBLICATIONS.

The Hardy Motor is a very compact gasoline engine. A description and illustration of its working parts is given in a 16-page catalogue issued by its manufacturers, the Hardy Motor Works, Port Huron, Mich.

A catalogue of the Hopkins gasoline engine, reversible propellers, and high-speed launches has been issued by the Noye Manufacturing Company, Buffalo, N. Y. Dimensions, prices, and illustrations are given.

Opinions on subjects are useful to those about to invest money in certain things. The opinions of some of the users of the motors made by the Buffalo Gasoline Motor Company, Buffalo, N. Y., are stated in a leaflet issued by this company, in which expressions of unqualified approval are given.

The A, B, C system of disc fan ventilation is described in catalogue No. 140, issued by the American Blower Company, of Detroit, Mich. Therein will be found illustrated descriptions of fans for the various requirements of ventilation and the details, construction, and different forms of improvement used; tables giving dimensions of fans and capacity, etc.

The Daimler Manufacturing Company, 939 Steinway avenue, Long Island City, New York, is selling many motors this season. The output of motors, launches, yachts, and automobiles is described in a handsome 28-page catalogue. These marine engines are used not only for propelling pleasure craft, but are being sold to oystermen and fishermen, who now can bring in their catches regardless of wind.

Victor boiler rivets are described in a booklet entitled "Scientific Facts and Other Valuable Information About Rivets." Therein are contained views of various types of boilers on which Victor rivets have been used, specimens of rivets which have been subjected to rivet tests, etc. It is shown that these rivets have stood remarkably well in the various types of boilers. The catalogue is issued by the Champion Rivet Company, of Cleveland, O.

The American Blower Company, Detroit, Mich., has recently issued sectional catalogue No. 139, which is very handsomely printed and of 70 pages. Therein are described the company's various systems of drying by moist air and hot blast. This catalogue will be specially valuable to those interested in kiln drying, as the different requirements for successfully operating dryers are taken up, as well as descriptions of the apparatus made by this company.

Motive-driven air compressors are being used more and more in several lines of service. Those manufactured by the Christiansen Engineering Company, Milwaukee, Wis., are described and illustrated in a handsomely printed catalogue. This company builds stationary compressors for continuous and intermittent service, and portable compressors for intermittent service and of various capacities. Transforming from electrical to pneumatic power is accomplished in a most efficient manner by these machines, the points claimed for them being their simplicity, interchangeability, durability, and compactness.

A complete catalogue, No. 10, has been issued by the Electric Launch Company, of Bayonne City, N. J., describing the launches and yachts recently built by the company, with a description of the well-equipped batteries, with table of storage charges for small boats, and an account of the high-class construction of the hulls. Then follows a description of the electric equipment, electric storage battery, views of electric launches, which are built on a fine model and handsomely finished, and plans of these boats of various sizes. The company also equips launches with gasoline engines, and in the catalogue will be found plans of yachts with auxiliary power. For generating electricity to supply the electric launches, the company supplies plants driven by kerosene, gasoline, and steam. This catalogue is one of the best that have come to our attention and will be of interest to all those contemplating buying motor boats.

When writing to advertisers please refer to MARINE ENGINEERING.

A pocket catalogue has just been issued by the Gere Launch and Engine Works, Grand Rapids, Mich., in which are given illustrated descriptions of the launches and gasoline marine engines manufactured by this company.

The Lee Injector Manufacturing Company, 99 Abbott street, Detroit, Mich., has just issued trade catalogue No. 5, in which are described injectors, ejectors, check valves, pipe strainers, etc., manufactured by the company. Tables of sizes and prices are given and also a concise article on the uses of ejectors.

The Salamandrine Boiler Company, 220 Broadway, New York, manufacturer of the Salamandrine boiler, has issued a catalogue describing this type of boiler, in which is shown the interior arrangement of the boiler. This boiler consists of a series of coiled tubes leading to a central vertical cylinder.

A large catalogue describing the gasoline and steam yachts and gasoline engines built by the Michigan Yacht and Power Company and Sintz Gas Engine Company, Consolidated, of Detroit, Mich., is now being distributed. Views are given of the several kinds of launches and marine engines, showing the working details and construction of machinery. Several handsome views are given of the latest launches built by this company in supplement No. 10.

The Caskey portable punch, which, before placing on the market, underwent the most severe and searching tests, is described in a handsome 16-page illustrated catalogue issued by the manufacturers, F. B. Slocomb and Company, Wilmington, Del. The catalogue states that the first Caskey machine punched upward of 90 per cent. of the holes in two torpedo boat destroyers, and since that time many machines have been sold on account of their merits.

Economy, durability, and beauty are the points claimed for the marine paints made by the Sherwin-Williams Company, whose offices are in Cleveland and other large cities throughout the United States. In a leather-bound catalogue, entitled "Paints for Marine Uses," are given samples of various colors for hull and cabin paint, enamel paint, deck paint, copper paint, etc. The catalogue is also handsomely illustrated with views of many well-known ships.

Lumen, the new bearing bronze, invented by Prof. R. C. Carpenter, of Cornell University, and manufactured by the Lumen Bearing Company, 1155 Sycamore street, Buffalo, N. Y., is described in a 16-page handsomely illustrated catalogue. It is stated that, owing to the many excellent qualities of this bearing metal, which, by the way, is not a babbitt, it is extensively replacing high-grade bronzes and machinery bearings of many kinds. The specific gravity of Lumen is 6.93; it weighs 4 ounces to the cubic inch; its average tensile strength is 30,000 pounds per square inch, the torsional strength 35,000 pounds per square inch, and the compressive strength 75,000 pounds per square inch. It is stated that its coefficient of friction under the same lubrication is lower than that of the best grades of phosphor bronze.

The Navigator or Mariner's Guide is the subject of a handsome trade publication of 150 pages published by the New Jersey Paint Works, of Jersey City, N. J. The work is well illustrated; first, with a color plate of pennants of the international code, and then with views of many prominent vessels. First is given a brief history of the American cup races, then an article on the hull and rigging of vessels. Then follow pictorial comparisons of the earliest and latest vessels of the different types, namely, river, sound, ocean, and harbor service. Space does not permit us to mention all the items of interest in this book, but some of them are the law of storms, management of boats, disturbances of the sea, notes on cargo and bills of lading, etc.; mathematics, including dead reckoning, longitude and latitude calculations, and pilot rules. To this reading matter are supplemented charts of the harbor of New York and contiguous waters in the Atlantic. This book will be sent upon receipt of 25 cents postage to those mentioning Marine Engineering.

AMONG THE FINE MECHANICAL TOOLS WHICH WE MANUFACTURE FOR THE USE OF ENGINEERS AND MACHINISTS

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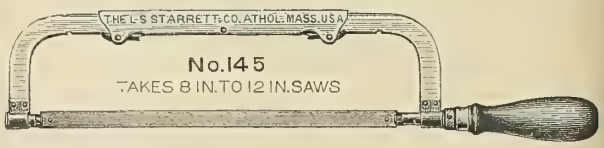
Hack Saws and Frames



FOR SAWING TUBING, BRASS, COPPER AND SHEET METAL.

These blades are made of the finest steel; the teeth are sharp and too hard to file.

Every Engineer should have them among his tools.

The L. S. Starrett Co., Athol, Mass.

A copy of our Catalogue No. 16 L can be had for the asking.

Ship's Deck Pumps,
Bilge Pumps,
Triplex Power Pumps.

PUMPS

We make
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POWER PUMPS
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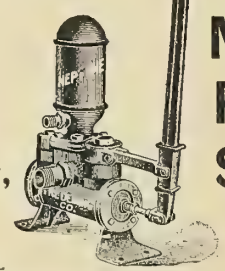
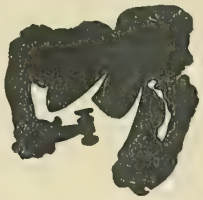


The Deming Company,
SALEM, OHIO.

HENION & HUBBELL, -
Gen'l Western Agts., CHICAGO, ILL.

The Prophet Chamber is the title to "Four-Track Series" No. 15, issued by the New York Central Railroad. Therein are lists of many hotels and private houses upon the line of this railroad, the price of board and cost of transportation to and from New York. Copies can be had free from General Passenger Agent George H. Daniels.

Summer tours over the Cleveland and Buffalo Transit Company's lines, head offices Cleveland, O., are described in an interesting pamphlet issued this season. Herein will be found descriptions of the vessels, the route traversed by them, and the points reached, which include many famous summer resorts. There is also enclosed a list of the prices of tickets to the various points. The steamers leave Buffalo daily at 6 P.M. for Cleveland, and leave Cleveland at 8 P.M. for Buffalo. During July and August an extra trip is made on Saturday each way.



THE reason Dixon's Pot-Lead is the best treatment for the hulls of yachts, launches and other fast craft is because of its perfect smoothness. It offers less friction to the water, and every bit of friction means loss of speed. We have had seventy-five years of experience in the manufacture of graphite products. Our Pot-Lead, like our other products, is the best form of graphite for its purpose. Send for circulars.

JOSEPH DIXON CRUCIBLE COMPANY,
JERSEY CITY.

The cotton jacket for a rubber hose is mentioned in a leaflet issued by the Boston Belting Company, 256 Devonshire street, Boston, Mass. This is a seamless fabric woven directly over the hose, thereby greatly increasing the life and strength of the hose. The merits claimed for this Universal Cotton Jacket are that it neither kinks, bends out of shape, nor unwinds should a strand be broken.

Shipyard Machinery For Sale.

One 7-roll plate straightener, 68 inches between housings. Two Baird portable pneumatic compression riveters, 42 inches and 18 inches gap respectively.

CHICAGO SHIP BUILDING CO.,
East Side Station, Chicago.

Bausch and Lomb Plastigmat f-68 is the name of a new lens made by The Bausch and Lomb Optical Company, Rochester, N. Y. There are several qualities claimed for this lens that are not possessed by others.

The line of vertical milling machines manufactured by the Garvin Machine Company, Spring and Varick streets, New York, are described in catalogue No. 3, just issued. The catalogue also describes the new profiling machines and duplex milling machines made by this company.

Compressed air is finding many new uses, but none appear more interesting than those described in Catalogue A, recently issued by the American Compressed Air Company, of Milwaukee, Wis. The machines made are for use in cleaning carpets and upholstery in hotels or on shipboard.

Any one interested in machine shops should write for Catalogue E on engine lathes manufactured by Shoemaker and Boye, of Cincinnati, O. Views are given of the standard lathes, with and without turrets, and various other lathes up to 42 inches swing. A new device for feed and screw cutting has been applied to this machine.

The Industrial Press, New York city, has just issued Section A of the Mechanical Index, comprising machine tools, metal-working machinery, and accessories. Therein is contained, in alphabetical index, a list of all classes of machines and accessories and lists of makers of each. The first 40 pages are devoted to an index, in English, German, and Spanish, of tools and appliances.

The gasoline engines and launches manufactured by Palmer Bros., Cos Cob, Conn., have a very neat catalogue devoted to them, which is now being distributed. The catalogue is 5 by 7 inches in size and comprises 32 pages. It is neatly printed and contains a great deal of information regarding the various styles of gas engines, launch hulls and other specialties of this company. Probably a copy can be had free of charge by referring to MARINE ENGINEERING.

The Rideau lakes, river, and canal lead to a unique region comparatively unknown, but which affords a most interesting trip for the summer tourist. These waters form an inland waterway between the St. Lawrence River at Kingston and the Ottawa River at Ottawa, and are briefly described in No. 34 of the Four-Track Series. A copy will be mailed free on receipt of two cents postage by George H. Daniels, General Passenger Agent, Grand Central Station, New York.

A well-illustrated catalogue describing the small electric motors made by the Crocker-Wheeler Company, with main offices and works at Amphere, N. J., is now being circulated. For many years this company has devoted its attention to the manufacture of small motors as well as large machines. These motors are made in large quantities, with either 2 or 4 poles and from one-twenty-fifth to 35 horse power. They are used in automobile and machine shops and other services where small power is required.

WATCH THIS SPACE FOR OUR NUMEROUS SPECIALTIES.

WALWORTH MFG. CO. TOOLS and SUPPLIES for STEAM WATER and GAS USERS BOSTON MASS.

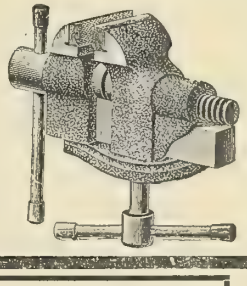
Walworth Extra Heavy Bench Pipe Vise

Is made especially for use in

MARINE REPAIR SHOPS AFLOAT AND ASHORE.

Grips pipe 1 by reason 8 to 6 inches inclusive, and of its solid and substantial "make up," also furnishes a first-class tool for general machine work.

Will not Crush or Jam Pipe Like Ordinary Vises



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New York, Park Row Building. **WALWORTH MFC. CO.,** Boston, 128 Federal Street.
Write for our BLUE CATALOGUE "D." showing complete line of engineers' pipe fitting tools.

BUFFALO STEEL PLATE FANS

HEATING, VENTILATING AND FORCED DRAFT

SPECIAL DESIGNS BUILT FOR ALL REQUIREMENTS

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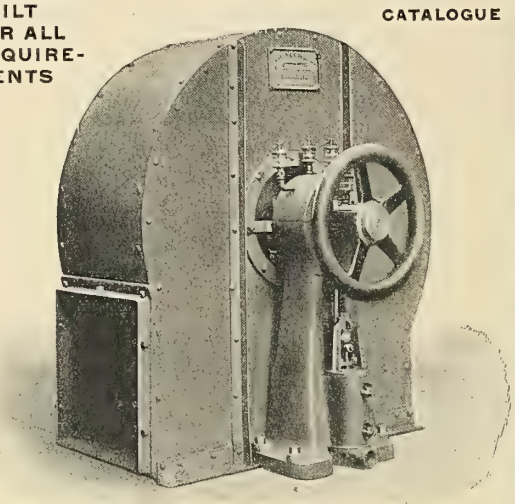

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BUFFALO, N. Y., U. S. A.

SHIPBUILDERS

Generally know that the only white pigment that will stand marine exposure is

ZINC WHITE

If there be any who are not aware of the fact, it will pay them to learn it.

THE NEW JERSEY ZINC CO.

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FREE: Our Practical Pamphlets

"The Paint Question," "Paints in Architecture," "House Paints: A Common Sense Talk About Them," "French Government Decrees."

A table of standard, lap-welded boiler tubes is issued by the United States Tube Company, of Buffalo, N. Y. This is a useful table to engineers and boiler makers.

In Catalogue No. 5 the American Steel and Wire Company, Chicago, Ill., describes the various kinds of extension, compression, torsion, and flat springs, valve springs, upholstery springs, etc., which it manufactures.

A Short Story of George Stephenson is the topic of a leaflet issued by Wyman and Gordon, Worcester, Mass. The company has issued a series of biographical sketches of prominent mechanical engineers, and will distribute them to those interested who mention MARINE ENGINEERING.

Volute photographic shutters, made by the Bausch and Lomb Optical Co., Rochester, N. Y., are attractively described in a 16-page catalogue issued by the company, in which are illustrations showing the manufacture of the shutter and the results obtained by instantaneous photography.

The economical handling of coal is receiving the attention of engineers and large suppliers of power throughout the country, and some notable examples of this class of machinery, made by the C. W. Hunt Company, 45 Broadway, New York, are described in catalogue No. 028, recently issued.

A catalogue of the parts of "Wood" arc dynamos, made by the Fort Wayne Electric Works, Fort Wayne, Ind., appears in an 84-page, 6½ by 4½ inches, catalogue recently issued. The catalogue embraces the prices of the various parts, each of which is enumerated, together with an index.

In the present day of improved office fittings the mechanical accountant holds a strong position where much figuring is to be done. The machine, which is made by the Mechanical Accountant Company, 184 Eddy street, Providence, R. I., is described in a leaflet recently issued. In Model B the machine can be made to add, subtract, multiply, divide, compute interest, and extract square and cube root by simply pressing the keys.

Instructions for installing Type A oil transformers are given by the manufacturers, the Fort Wayne Electric Works, Fort Wayne, Ind., in leaflet No. 3,008.

A brief sketch of the life of James Nasmyth, the inventor of the steam hammer, is given in a leaflet issued by Wyman and Gordon, Worcester, Mass., makers of drop forgings.

Ask Hopkins is the title of a leaflet issued by John C. Hopkins and Company, 119 Chambers street, New York City, dealers in canvas and duck and marine supplies. The company states that it is ready to answer all questions concerning sails, awnings, flags and tents, etc.

BUSINESS NOTES.

LAUNCHING THE LAWSON.—It has been decided to rig the seven-masted schooner *Thomas W. Lawson* before she is launched from the Fore River Shipyard at Quincy, Mass. Each of the steel masts weighs 17 tons without rigging.

FIELD GLASSES.—The Warner and Swasey Company, Cleveland, O., manufacturer of the new prism field glasses, is selling many of the new instruments, among the orders being a number of larger instruments sufficient to allot two to each battleship and cruiser of the U. S. Navy. The glass was chosen after a thorough comparative test by the experts of the Navy Department.

EXHAUST MUFFLERS.—The Loomis Automobile Company, Westfield, Mass., makes an exhaust muffler for deadening the sound of loud explosions in the exhaust of gasoline engines. The muffler is made of aluminum and asbestos, both of which materials, being dead, do not vibrate, and the muffler is so designed that the exhaust enters the atmosphere in a steady stream. Many users of this device have written to the manufacturers expressing their satisfaction.

Q and C Specialties.—The Q and C Company has again resumed operations and is devoting itself to a line of specialties of much interest to ship and engine builders. These specialties comprise pneumatic tools, including yoke and hand riveters, drills, hammers, etc., metal-sawing machines, shop saws of various kinds, etc. The principal offices of the company are in the Western Union Building, Chicago. The New York office is at 114-118 Liberty street.

A Free 300-Page Catalogue.—Messrs. Charles H. Besly and Company, 10-12 North Canal street, Chicago, Ill., report their business very good. They are receiving orders for Gardner grinders from all parts of the country. Within the past month shipments have been made to California, New York, Rhode Island, Connecticut, and New Jersey. The spiral circles in their various forms used in connection with spiral-grooved steel disc, which is the distinctive feature of the Gardner grinder, and, it is claimed, enables users of this grinder to do from 50 per cent. to 300 per cent. more work than either solid or coated wheel will do. Many shipments of Helmet oil, Badger and Bonanza grease cups are being made to all parts of the country. Numerous inquiries for catalogues and circular matter relating to their own specialties, as well as requests for general catalogues, estimates and prices on shop equipments, indicate a healthy condition of trade throughout the country. Their new 300-page illustrated catalogue will be sent free to any address upon application.

A New Submarine Paint.—A new anti-fouling paint has recently been put on the market by the Walker Chemical Works, of Harrison, N. J., and 52 Broadway, New York. This paint is a new departure in the field and is claimed to be entirely different from any other anti-fouling paint manufactured. It consists of a pyroxylin varnish, the guncotton solvent used being a special product of wood distillation. Its creosote origin is claimed to render it absolutely anti-fouling and poisonous to all animal and vegetable life. Before putting it on the market the manufacturers have subjected this compound to severe tests in waters of this latitude, and they report that their experiments prove that this paint will remain in practically an unchanged condition for a year; that it is not subject to the attacks of the teredo, and that neither oysters, barnacles, nor vegetable growths can get hold on its surface or live in its presence. In its natural condition this varnish is a transparent, almost colorless liquid, which can be made of any consistency desired by varying the amount of guncotton used. It dries flat and perfectly smooth, forming a waterproof celluloid surface where applied. For wooden surfaces the company furnishes metallic copper bronze, which is stirred in the pyroxylin varnish just before application, about a pound and a half being used to a gallon of the medium. It is then flowed on with a brush and the result is a bright, metallic, waterproof surface. The varnish can also be used with any other metallic powders, graphite, or bronzes not subject to corrosion by salt water.

For Steam Making Apparatus For Refrigerating

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HOHMANN & MAURER MFG. CO. ROCHESTER, N.Y.

For All Engineering and Manufacturing Purposes

Write for Illustrated Catalogue M

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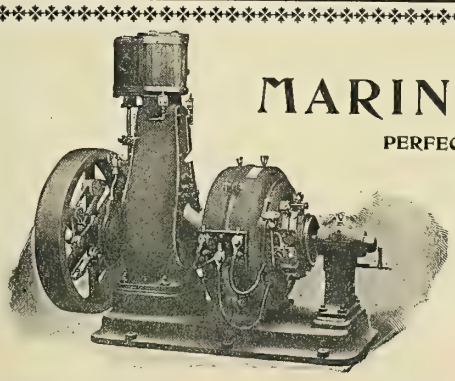
Moved to Larger Quarters.—The Edson Manufacturing Company has removed to large and ample quarters in the fine new building at 255 and 257 Atlantic avenue, Boston, Mass. With these increased facilities the company will be able to carry a larger stock of its many marine specialties, as both its manufacturing and stock-carrying facilities are more than double.

Philadelphia Pneumatic Tools.—The Philadelphia Pneumatic Tool Company is now entirely settled in its new shops at Twenty-first street and Allegheny avenue, Philadelphia. Considerable loss of time naturally resulted from moving, and the company reports being somewhat behind in making shipments. The works are being run night and day, however, to catch up, and orders will be filled with usual promptness at no distant date. A great deal of attention is being attracted to the Keller pneumatic hammers, made by this company, by reason of a recently devised improvement in their construction. On account of this improvement the working capacity of the chipping and riveting hammers is claimed to have been increased at least 25 per cent., and the vibration, inseparable from any pneumatic tool, is reduced materially. This applies to both chipping and riveting hammers. Recent large orders have been received from the Southern Pacific Company, Newport News Shipbuilding and Dry-Dock Company, Pennsylvania Railroad Company, Lackawanna Steel Company, and others.



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PERFECT SERVICE. LEAST SPACE, WEIGHT AND ATTENTION.

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SPRAGUE ELECTRIC COMPANY

General Offices: 527-531 West 34th St., New York

Chicago: Fisher Bldg. Boston: Weld Bldg. St. Louis: Security Bldg. Baltimore: Maryland Trust Bldg.

A MARINE PUZZLE FREE.—Berry Bros., Ltd., Detroit, Mich., who manufacture the well-known Berry Bros. spar varnish, will send to all inquirers who mention MARINE ENGINEERING, free of charge, a unique marine puzzle.

MARCK STEAM TRAPS.—E. F. Houghton and Company, 240-250 West Somerset street, Philadelphia, Pa., are distributing a circular devoted to the Marck steam trap. This circular contains a cut showing the manner of draining the low-pressure cylinder on a marine engine. There is also a picture showing the application of these traps to steam pumps, steam winches, steam cranes, etc.

CONSULTING ENGINEER.—William T. Keough, consulting engineer and naval architect, has removed to offices in the Whittier Building, 15 Exchange street, Boston, Mass. Mr. Keough makes a specialty of designing and superintending the construction of vessels and marine machinery of all kinds. He also makes examinations, surveys, and reports, and attends to other matters in the line of consulting and constructing in marine work.

FREE SAMPLE OF METAL POLISH.—George W. Hoffman, 295 East Washington street, Indianapolis, Ind., in order to still further introduce the U. S. metal polish, offers to send a free sample to any reader of MARINE ENGINEERING who will write for it.

NEW STEAMBOAT.—Messrs. Sinn and Page, naval architects and marine engineers, Baltimore, Md., have launched on Lake Sunapee, N. H., a new vessel for the Woodsum Steamboat Company. The hull was built by the Baltimore Dry-Dock Company and shipped in cars to the lake. The engines were built by J. H. Paine and Son, Boston, Mass.

WOLVERINE MOTORS.—The Wolverine Motor Company, Grand Rapids, Mich., has found it necessary to have a large stock of motors constantly on hand in New York, so a fine store has been opened at 25 Warren street, which will be in charge of C. L. Snyder, president of the company. Any information regarding motors and boats can be had at this office, as well as at the main office in Grand Rapids.

"BENEDICT-NICKEL" Seamless Condenser Tubes are the only tubes that are *not* readily effected by Electrolysis.

"Benedict-Nickel" is an alloy of nickel and copper. The tubing is stronger, tougher and denser than any other. By hot rolling a solid cylindrical billet upon a forming mandrel, it is made like a twist gun barrel.

Send for treatise, "Electrolysis of Condenser Tubes," which gives full scientific reasons for the superiority of "Benedict-Nickel."

We are also large manufacturers of brass and copper tubing, made by the same process as "Benedict-Nickel," and of brass and copper sheets, wire, etc.

BENEDICT & BURNHAM MFG. CO.,
Main Office and Factory, Waterbury Conn.
New York, 253 Broadway. Boston, 172 High Street.

V. WARING, N.Y.

FREE!! GIVEN TO all ENGINEERS SENDING US A TRIAL ORDER

A bound book on Engineering, valued at $1.50. We are sole agents for the best line of Asbestos Packings on earth. Including Sheeting, Piston, and Gaskets

BESTOSKING PACKING & SUPPLY CO.,
170 Summer St., Boston
Agents for
TURNER BROS., ROCHDALE, ENGLAND

GASKET WISDOM

Advises the adoption of the

McKIM GASKET

wherever long service with no worry is wanted.
Made of packing encased in soft annealed copper.
Can be reapplied indefinitely.
All sizes for manhole, hand-hole and pipe fittings.
Write for prices and catalog.

McCORD & COMPANY

104 BROADWAY - - NEW YORK
1471 OLD COLONY BLDG. - CHICAGO

RAPID BLUE-PRINT PAPER.—The popularity of the "Rapid" blue-print paper, manufactured by the Pittsburg Blue Print Company, Park Building, Pittsburg, Pa., is shown by the fact that over 50,000 yards of this paper were sold during the month of May.

CLEVELAND PNEUMATIC TOOLS.—Owing to a great increase in trade on the Pacific coast, the Cleveland Pneumatic Tool Company, Cleveland, O., has established an agency on the Pacific coast, having given this appointment to the Compressed Air Machinery Company of San Francisco. A full line of Cleveland tools will be kept in stock.

MOTOR-DRIVEN MACHINES.—The Sprague Electric Company, 527 West Thirty-fourth street, New York City, continues to have a large demand for electric motors for use in direct connection to machinery and tools of various kinds. One of the latest orders filled was that of equipping the plant of the U. S. Playing Card Company, Cincinnati, O., where all of the machines will be operated by Sprague electric motors.

HUNTER'S POINT DRY-DOCK.—The Hunter's Point Dry-Dock, San Francisco, Cal., which is being enlarged, has been equipped by the following San Francisco parties: C. C. Moore and Company furnished the boilers; W. T. Garret and Company, the pumps; J. J. Beaton is the superintendent; H. C. Holmes is chief engineer of construction; and J. Hubacher is the chief engineer for the dry-dock company. Oil is burned under the boilers.

EDUCATED BY CORRESPONDENCE.—Among the recent graduates of the American School of Correspondence, Boston, Mass., were Frank B. Fuller, Swampscott, Mass., who completed the marine engineering course in sixteen months, and Ray O. Caukin, Jackson, Cal., who completed the electrical engineering course in the same time. Mr. Fuller is employed by the Boston and Maine Railroad Company, and Mr. Caukin by the Standard Electric Company of California. The record of another graduate, Mathias Knopf, of Newark, N. J., who completed the stationary engineering course while working as a fireman, shows what an ambitious man can do when he determines to gain a technical education. At the time he enrolled Mr. Knopf was not at all familiar with the English language. This delayed him somewhat on the earlier papers, yet he made rapid progress. J. A. Gonstead, an engineer in the Minneapolis, Minn., fire department, devoted spare time to the electrical engineering course and completed it, also a course in mechanical drawing, in sixteen months. Another recent graduate in electrical engineering was George E. Higgins, superintendent of the Montreal agency of the Bell Telephone Company. Among foreign students who recently received their diplomas were Frank W. Burford, Timaru, N. Z., and Arthur E. Moss, Port Chambers, N. Z. It is interesting to note that the average age of these men when they became students in the American School was thirty years, the youngest being twenty-three and the oldest thirty-five, and that they were regularly employed in some trade or profession while pursuing their studies.

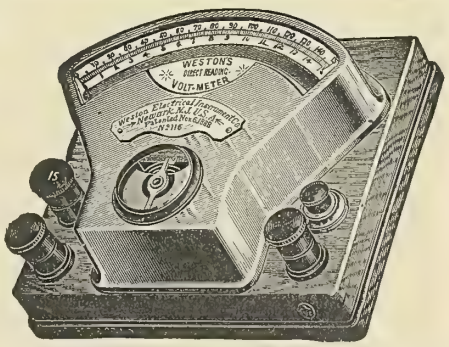
WESTON STANDARD PORTABLE
DIRECT-READING

Voltmeters, Ammeters, Millivoltmeters, Voltammeters, Milliammeters, Ohmmeters, Portable Galvanometers, Ground Detectors and Circuit Testers.

Our Portable Instruments are recognized as **the standard** the world over. Our **Voltmeters** and **Ammeters** are unsurpassed in point of extreme accuracy and lowest consumption of energy.

WESTON ELECTRICAL INSTRUMENT CO.,
Waverly Park, Newark, N. J., U. S. A.

BERLIN:—European Western Electrical Instrument Co., Ritterstrasse 88.
LONDON:—Elliott Bros., 101 St. Martin's Lane.



WESTON Standard Portable Direct Reading Voltmeter.

NEVER-STICK BLOW-OFF VALVE.—The Walworth Manufacturing Company, Boston, Mass., reports a very large trade in Never-Stick boiler blow-off valves. The particular features of this valve are briefly summed up as follows in a circular: The head of the plug has a firm bearing against the locking ring. The plug is adjustable and the valve need not leak. It has a large taper and cannot wedge or bind. The pressure on the plug does not destroy the packing. The working parts are protected and safe from severe wear. The port is inside the plug and cannot be injured by cutting with scale. The valve is thoroughly made, for high or low pressure, and is always tight and ready for use, or after long service can be made so with little trouble. It is now in use in several important steam vessels, and is fully proving that the broad claims made for it are well grounded. This valve is also made in straight pattern, where high-grade, quick-opening, serviceable valves or cocks are desired, extra heavy or standard weight; flanged or screwed.

COTTON JACKET FOR HOSE.—The Boston Belting Company, 256 Devonshire street, Boston, Mass., is now prepared to supply rubber hose with Universal Cotton Jacket. This is a heavy seamless fabric, woven directly over rubber hose. Its use greatly increases the strength of the hose to which it is applied and also adds much to its capacity to withstand the wear and tear of being dragged about. The jacket is painted, thus rendering it waterproof. It does not kink or get out of shape, and does not unwind should a single strand be cut. These, and the other claims for this jacket, will be much appreciated by users of hose, whether for air, water, or steam.

A $10 BARGAIN

We have on hand only a few sets of MARINE ENGINEERING, as follows:

1899, Vols. III–IV; 1900, Vol. V;
1901, Vol. VI;

bound in black cloth with leather corners and back.

The price for the set is $10.00.

The price per volume is **$4.00.**

Floor space in offices on Broadway costs so much that we shall not attempt to keep complete volumes or back numbers of the magazine any longer, and while the sets last we will sell them for **$10** complete, carriage to be paid by the purchaser. No reduction in price for single volumes.

The period 1899–1901 marks a turning point in the history of shipbuilding in this country, hence these volumes are of great historic as well as technical value.

MARINE ENGINEERING

309 Broadway, New York

The modern steam vessel contains such a mass of machinery that Professor Durand in his book, "Practical Marine Engineering," has devoted a chapter to the subject of

AUXILIARIES

The contents of this chapter are as follows:

Circulating Pumps,
Condensers,
Air Pumps,
Feed Pumps and Injectors,
Feed Heaters,
Filters,
Evaporators,
Direct Acting Pumps,
Blowers or Fans,
Separators,
Ash Ejectors,
General Arrangement of Machinery.

THE CHAPTER ON REFRIGERATION

has the following contents:

General Principles,
Refrigeration by Freezing Mixtures,
Refrigeration by Vaporization and Expansion,
Principal Features of Ammonia Refrigerating Apparatus,
Refrigeration by the Expansion of a Compressed Gas,
Principal Features of Compressed Air Refrigerating Apparatus,
Operation and Care of Refrigerating Machinery.

THE CHAPTER ON ELECTRICITY

is as follows:

Introductory,
The Dynamo,
Wiring and the Distribution of Light and Power,
Lamps,
Operation and Care of Electrical Machinery,
Routine Care,
Faults.

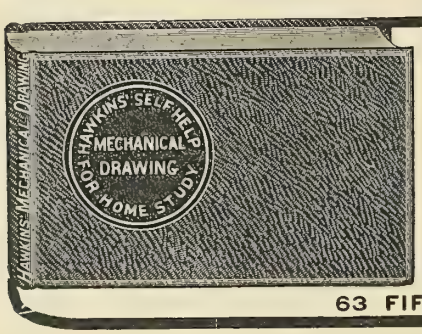
The other equally as complete chapters are devoted to **Fuels, Boilers, Engines, Operation, Management and Repairs, Valves and Valve Gears, Indicators and Indicator Cards, etc.**

The book comprises over 700 pages and has nearly 400 illustrations.

PRICE OF THE BOOK $5.00

Delivery free of carriage to any part of the world.

MARINE ENGINEERING, 309 Broadway, New York



Learn to Draw. This book, as shown in illustration is a self-instructor for home study and practice in the art of Mechanical Drawing for Engineers, Machinists, Electricians, Metal Workers and all interested in Drafting for shop practice, and has been prepared in plain practical language, and illustrated, by the author of "Hawkins' Educational Works." The book is divided into 28 different subjects which comprise the fundamental principles of drawing, each heading being thoroughly treated. There are 320 pages, 300 illustrations and diagrams. The book is handsomely bound in green cloth, gold edges and titles, size 7 x 10½ in., printed on fine paper. Upon receipt of $2 the book will be sent to any address prepaid, money returned if not as represented, order to-day; see order coupon.

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Educational Book Publishers

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Order Coupon. Cut Out.

Date 1902

Enclosed find Two Dollars for which ship me at once one copy of Hawkins' Mechanical Drawing.

Name.....

Address.....

NEW PRESIDENT ELECTED.—The directors of the American Screw Company, Providence, R. I., have chosen Samuel M. Nicholson as the executive head of the company. Mr. Nicholson is president and general manager of the Nicholson File Company, probably the largest file and rasp concern in the world, which controls six large plants with home offices at Providence, R. I.

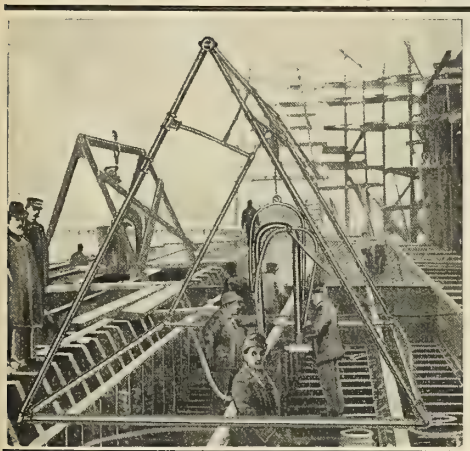
COMPACT LAUNCH BOILER.—The Salamandrine Boiler Company, 220 Broadway, New York, manufactures a very compact water-tube boiler, in all sizes up to 50 horse power, which is designed especially for use in yachts and launches. The boilers are so constructed that they can be used with coal or any form of petroleum for fuel. The heating surface of the 6 horse power boiler is given as 60 feet and of other sizes of boilers in proportion.

LOSS IN HANDLING OIL.—In a booklet issued by F. S. Bowser and Company, Incorporated, Fort Wayne, Ind., a great deal of information is given regarding the Bowser oil tanks. These tanks are described as a positive economy, as they save oil, money, time, and labor. They pump gallons, half-gallons, and quarts at a stroke. They are neat, clean, handy, and enforce economy whether the users of it wish to or not. The booklet says that the loss of a gallon of oil is not serious, yet it is the equivalent to losing the interest on a dollar for a year. Users of oil will read the booklet with much interest.

A COMPACT PAINTING MACHINE.—The Patton Paint Company, Milwaukee, Wis., reports that it is selling a great many of its painting machines. This is a compact device operated by hand, equally adapted for exterior and interior painting. The entire machine weighs only twenty-five pounds, and one man can handle it and with twenty-five feet of hose and a 7-foot nozzle pipe can paint almost anything. The claim is made that this machine does not use any more paint than when paint is applied by the brush, and that two men will average 20,000 square feet of surface a day, ten times as much as one man can paint in a day with a brush, using the same amount of paint per square foot. Circulars regarding this machine are issued by the manufacturers.

A FINE LAUNCH.—Mr. Philo E. Remington, president of the Remington Automobile and Motor Company, Utica, N. Y., writes of an interesting trip which he made last month in a Remington launch. He states that on June 14 he left Albany in a 26-foot Remington launch, equipped with one of their four-cycle motors, for the purpose of making a record trip from Albany to New York. The time of leaving Albany was 3:30 A.M., which time is certified to, and the time of arrival at 152d street, North River, New York, was 6:30 P.M. the same day, which arrival is likewise certified to. Mr. Remington reports that the motor never stopped once during its entire trip, thus having run continuously for fifteen hours during the entire distance of 150 miles. The company has recently made a gasoline consumption test of that same boat, with the result that twenty gallons of gasoline were used in traveling 325 miles.

MARINE PAINT ECONOMY.—The Sherwin-Williams Company, Cleveland, Ohio, issues a neat booklet entitled "Marine Paint Economy," which states: Real economy in vessel painting comes through good quality paints. Good quality means greater durability and greater spreading capacity. It means fewer times of repainting and fewer gallons of paint. In the grinding and mixing we exercise the closest watch-care. Everything is exact and accurate. There's no chance for mistakes. The finished product must pass through the practical test room before it is allowed to be sealed in the cans. Its working qualities, drying qualities, color, etc., are thoroughly examined. In filling we are guided by weight as well as measure. The company operates four large plants at Cleveland, Chicago, Newark, and Montreal, and maintains warehouses and offices at New York City, Boston, San Francisco, Kansas City, Toronto, Los Angeles, and Minneapolis. Readers are asked to write for the catalogue of marine paints.



YOKE RIVETERS

THE Q AND C

MOST ECONOMICAL AND EFFECTIVE METHOD OF RIVETING

PNEUMATIC TOOLS OF ALL KINDS

Q & C HAMMERS
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THE Q & C COMPANY

114 LIBERTY STREET, NEW YORK
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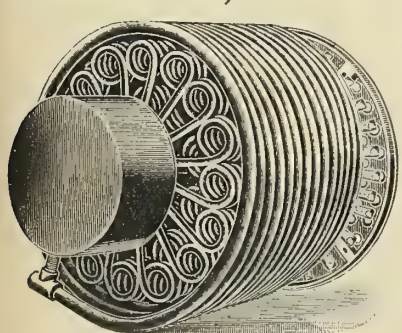
FACTS, NOT FAIRY TALES.



*PATENT PENDING.

The continuous use of Salamandrine Boilers by our numerous customers shows such wonderful efficiency as positively to put in the shade all other existing types of steam boilers.

From being a nuisance when equipped with ordinary boilers, steam craft now employing the Salamandrine afford pleasure and the highest satisfaction.

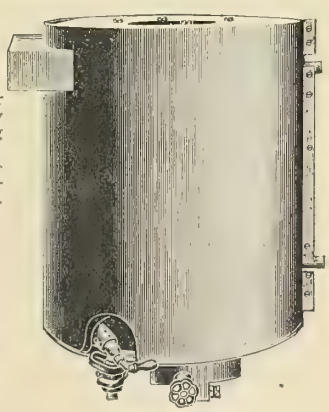
SOME OF OUR FACTS:

Cannot burn out at the bottom.
Cannot explode.
The quickest generator of steam.

SALAMANDRINE BOILER COMPANY,

Works: Newark, N. J., U. S. A. 220 Broadway, New York.

SEND FOR DESCRIPTIVE PAMPHLET.



PATENT PENDING

The Peerless Spiral Piston and Valve Rod Packing

It will hold 400 lbs. of steam

Once tried always used

Will run twelve months in high speed engines

Arctic Packing

To be used exclusively for packing Ammonia Pumps

This packing is made in several hundred sizes

This packing is specially constructed for ice machine service, of layers of rubber and plies of duck which are so arranged and laid as to best resist the actions of ammonia, cold and heat.

The duck is a specially made duck, frictioned with an entirely new compound heretofore unknown to the rubber trade, and the core and back is of the celebrated Rainbow Packing compound, which is specially adapted to resist ammonia, cold and heat.

This packing is constructed on a strictly scientific basis, and the results obtained thus far have demonstrated fully its value for ammonia packing.

This packing is made in several hundred sizes. The rings may be slipped onto the rod very readily.

The usual rule is to be observed in giving measurements, the depth and width of stuffing box and size of piston rod, in order to get the size desired.

Sole Manufacturers of the

Celebrated Rainbow, Eclipse Sectional Rainbow Gasket, Hercules Combination and Honest John Packings.

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These Goods can be Obtained at All First-class Dealers.

The advertisements on pages 14-20

are devoted to

Boiler Room Equipment

as follows:

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ASH EJECTORS.
Davidson, M. T.

ASH HOISTS.

BLOWERS—Also see VENTILATORS.
American Blower Co.
Boston Blower Co.
Buffalo Forge Co.
Sturtevant Co., B. F.

BLOW-OFF VALVES—See VALVES.

BOILERS—Also see ENGINE BUILDERS; also SHIP BUILDERS.
Almy Water Tube Boiler Co.
Boyer Patent Sectional Water Tube Boiler Co.
Kingsford Foundry and Machine Works.
Lake Erie Boiler Works.
Rochester Machine Tool Co.
Salamandrine Boiler Co.
Stirling Co., The.
Thorpe-Platt & Co.
Thropp, John E., & Sons Co.

BOILER COMPOUND.

BOILER FEED PUMPS—See PUMPS.

BOILER PLATE.

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BOILER TUBES.
National Tube Co.
Shelby Steel Tube Co.

CORRUGATED FURNACES—See FURNACES.

EXHAUST FANS—See BLOWERS.

EXHAUST HEADS.
Sturtevant Co., B. F.

EXPANSION JOINTS.

FANS—See BLOWERS.

FEED CHECK VALVES—See VALVES.

FEED WATER FILTERS.
Ross Valve Co.

FEED WATER HEATERS AND PURIFIERS.
Learmonth, Robert.

FIRE ROOM PLATES.

FIRING TOOLS.

FLUE CLEANERS.

FORCED DRAFT—See BLOWERS.

FURNACES.
Continental Iron Works.

GAUGE COCKS—Also see STEAM FITTINGS.

GRATES.

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Eynon-Evans Mfg. Co.
Lunkenheimer Co., The.
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STEAM SEPARATORS.
De Rycke, Joseph, & Co.

STEAM TRAPS.
Buffalo Forge Co
Helios-Upton Co.
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Sturtevant Co., B. F.

STOP VALVES—See VALVES.

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Ashton Valve Co.
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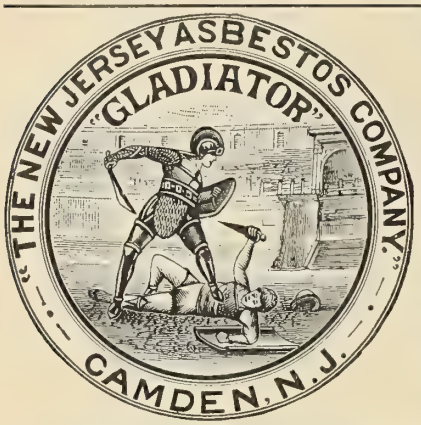
Eynon-Evans Mfg. Co.
Foster Engineering Co.
Kennedy Valve Mfg. Co.
Lunkenheimer Co., The.
Mason Regulator Co.
Star Brass Mfg. Co.
Walworth Mfg. Co.

VENTILATING FANS—See BLOWERS.

WATER GAUGES.

WHISTLES.
American Steam Gauge and Valve Mfg. Co.
Chapman Valve Mfg. Co.
Lunkenheimer Co., The.
Star Brass Mfg. Co.

If specialties are wanted which are not advertised, Marine Engineering Information Bureau will furnish names of manufacturers and dealers.



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THE NEW JERSEY ASBESTOS COMPANY

Original and only manufacturers of the far-famed

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Asbesto-Metallic Sheet Packings, Valve-Stem and Piston Rod Packings and Gaskets.

The only Packings and Gaskets which have given, and continue to give, uniform satisfaction throughout. Will resist the highest steam pressure, and the Sheeting and Gaskets can be used over and over again without impairing their efficiency.

N. B.—All goods of the same character on the market are imitations, and, almost invariably, are of foreign manufacture.

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47 Dey Street, New York.
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117 N. Front St., Camden, N. J.

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For Marine and Other Uses

THE NATIONAL TUBE CO.

The Largest Manufacturer in the World of Wrought Iron and Steel Tubular Goods, is now prepared to accept orders in any quantity and for any size of

SEAMLESS TUBES

SALES OFFICES

NEW YORK—26 Cortlandt Street
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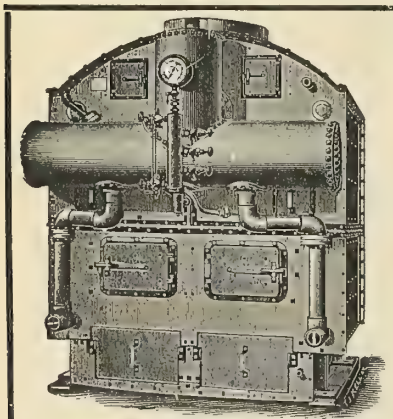
PITTSBURG—Conestoga Building
PHILADELPHIA—267 S. Fourth St.
ST. LOUIS—Security Building
LONDON, ENGLAND—Dock House, Billiter Street

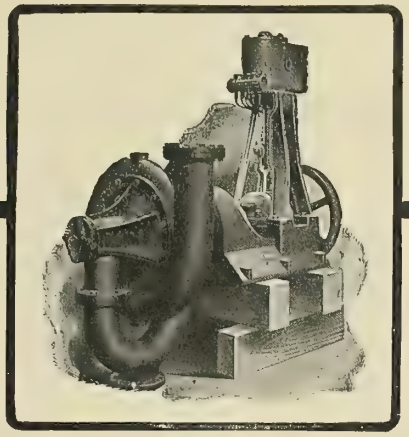


OUR BOILERS ARE NOW INSTALLED IN OVER

130 Steam Yachts, ... 1 to 5 Boilers Each.
60 Passenger Steamers, Tugs and Lighters, ... 1 to 6 Boilers Each.
15 Vessels in the Government Service.
40 Steam Launches. 75 Stationary Plants.

ALMY WATER-TUBE BOILER CO.

PROVIDENCE, R. I.



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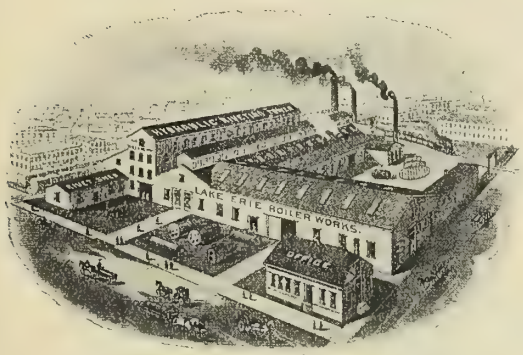
Marine Boilers

INTERNALLY FIRED TYPES.

KINGSFORD FOUNDRY AND MACHINE WORKS
Oswego, N. Y.

Lake Erie Boiler Works

RICHARD HAMMOND, Proprietor



THE BEST EQUIPPED PLANT IN AMERICA FOR THE MANUFACTURE OF MODERN MARINE BOILERS.

BUFFALO - - NEW YORK

WHEN using mechanical draft keep tab on it by means of our fire room telegraph system. You thus have the most power when it is wanted, and there is no unnecessary waste of coal.

WE ALSO MAKE

Engine Room Telegraphs

AND

Steering Telegraphs.

R. E. KIRK JR. CO.,
Baltimore, Md.

TO HAVE A JOINT
Fitted with a Merwarth Metallic Gasket is to have a joint
TIGHT TO STAY TIGHT

MERWARTH METALLIC GASKET CO.
SAMPLES FREE NOW
120 Liberty Street
NEW YORK

WATER FILTERS REGULATORS & ENGINES

ROSS REGULATING VALVES will control the flow and maintain any desired pressure.

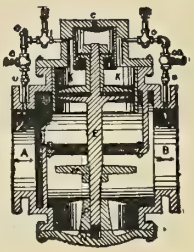
Their extensive use demonstrates their efficiency.

Write us for evidence.

THE ROSS VALVE CO. TROY N.Y.

PRESSURE REGULATING VALVES
For all Purposes.

Perfection in the control of Steam, Water, Air.



Engineers Afloat

testify to the simplicity and safety of

Kennedy Valves

for all pressures. We also manufacture valves and gates for

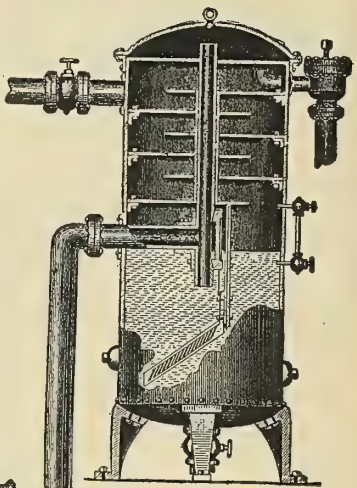
WATER, STEAM, GAS, OIL, AMMONIA.

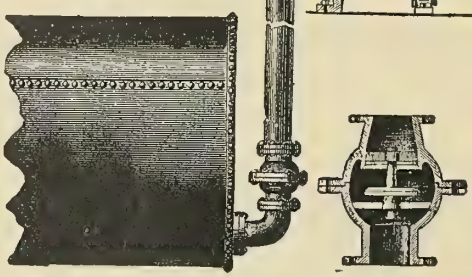
Leading jobbers carry our goods and there is always a full stock at our New York warehouse.

The Kennedy Valve Mfg. Co.,
63 Beekman St., New York.

The BUFFALO
Feed Water Heater and Purifier.

Used on many of the large and most economical steamers on the Great Lakes under various steam pressures up to 250 pounds. A most efficient apparatus. Send for catalogue.





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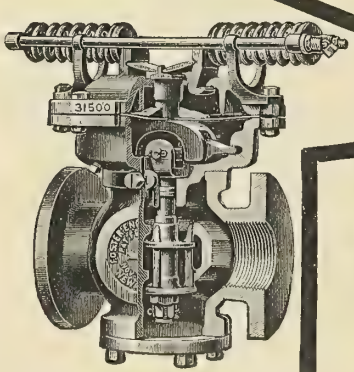

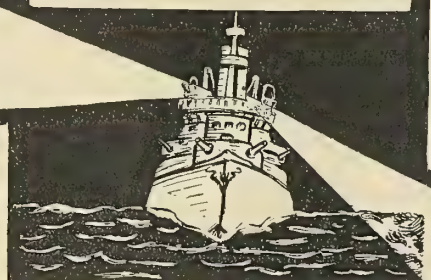

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TRADE PUBLICATIONS.

"**What's New**" is the title of a 4-page folder issued monthly by the Spreckels-Crawford Company, 713 Market street, San Francisco, Cal. This folder is issued in order to describe recent inventions and improvements, and, we infer, is sent free to all who are interested in steamship supplies, machinery, and other similar lines.

Air Compressors is the name of a little catalogue issued by Herron and Bury Manufacturing Company, Erie, Pa. This company makes a straight-line air compressor; also, a center-crank compressor. Besides these machines, the company builds a complete line of air receivers. The catalogue gives dimensions of the machines and tanks.

A Safety Tread for covering ships' ladders and stairways, steps of public buildings or staircases, is manufactured by the American-Mason Safety Tread Company, 40 Water street, Boston, Mass. The company has issued a handsome 28-page catalogue describing its non-wearable, unslippery treads, and most of the space in the catalogue is devoted to enumerating and illustrating the buildings in the different States of the country where these treads are in use. Many naval vessels, steamships, and yachts use this tread on their staircases.

Tool Makers' Engine Lathes are handsomely described in a new 10-page catalogue issued by the Pratt and Whitney Company, Hartford, Conn. This company has designed and placed on the market a new 10-inch by 5-foot engine lathe for the use of tool and model makers, and for all purposes where accuracy and convenience are essential. The bed of the machine is cast in one piece with the pan. The head spindle is made of selected crucible steel, ground, and runs in babbitt bearings. All other parts of the machine have been made of selected material and finished in a most careful manner. Copies of this catalogue can be had by applying to the main office or any of the agencies and mentioning MARINE ENGINEERING.

Brennan Standard Gasoline Motors for marine or automobile purposes are described in a 16-page, illustrated, pamphlet issued by the Brennan Manufacturing Company, Syracuse, New York. The points about this motor are that it has great range of speed and power, does not vibrate, is of moderate weight, and is economical with fuel. All motors are of the four-cycle type and are built with one or two cylinders. When of two cylinders, these are mounted horizontally with cylinders on opposite sides of the shaft. The method of cooling can be either by water jacket or by air; when of the latter type, the cylinders are made with large radiating surfaces. This company also manufactures the various items of equipment for a gasoline engine, namely, the carbureter, muffler, sparking plug, spark coil, and transmission gear. A copy of the catalogue may be had upon writing the manufacturers.

A new boiler which is now on the market, possessing some new features, is called the Salamandrine, manufactured by the Salamandrine Boiler Company, 220 Broadway, New York city. Tests are stated to have been made with this boiler of repeatedly evaporating every drop of water contained in it, and then turning on cold water and raising steam to 200 pounds pressure, without apparent injurious effect. It is also claimed that the circulation of the water throughout the coils is so perfect and so rapid that scales do not form in the coils. The boiler is made up of spiral coils placed vertically and connected to a central vertical drum. Outside of all is a spiral coil water jacket. Among the points claimed for it are that it will not burn out; is non-explosive; that steam can be raised to 220 pounds pressure from cold water in two and one-quarter minutes; can stand a steam pressure of 1,000 pounds; is economical; is made with all parts interchangeable; the burner cannot be extinguished by back draft. The company is prepared to install these boilers in steam yachts and launches, and other craft where boilers are needed not to exceed 50 horse power.

When writing to advertisers please refer to MARINE ENGINEERING.

The Superior is the title of a 36-page 6 by 9-inch catalogue issued by the Lake Shore Engine Works, Marquette, Mich. The catalogue takes up in detail the Superior engine, describing the design and material of each part of the machine. Then is shown and described a U. S. lifesaving station lifeboat equipped with Lake Superior engines. One double-cylinder machine is placed in the after air compartment, and runs through two sets of gears to shafts with propellers attached. Next is shown the layout of the plans of a launch, and then the various styles and sizes of a Superior engine. This company also builds standard size launches, and another large department is that of building machines for stationary service.

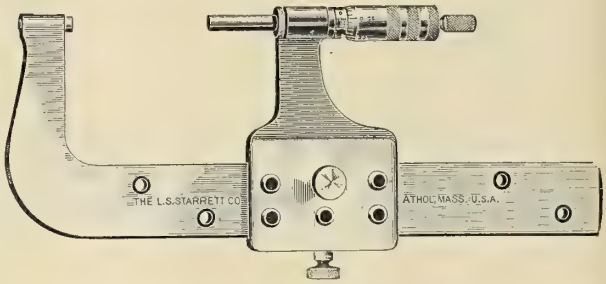
Motor-Driven Tools is the name of an artistically bound and handsomely engraved catalogue issued by the Crocker-Wheeler Company, manufacturers and electrical engineers, Ampere, N. J. The catalogue is bound in burlap and the pages are 7 1-2 by 10 inches. The descriptions and illustrations are in the main types of machines to which the electric drive has been applied. Engravings are given of each machine, showing the location of the motor. An enumeration of the machines to which these motors have been applied, and which are illustrated in the catalogue, includes: punches, shears, drill presses, shapers, finishing rolls, slotting machines, pressure blowers, lathes, ammonia pumps, band saws, etc., etc. The Crocker-Wheeler motor is used on both heavy and light machines and is either geared or bolted to the shafting. Copies of this catalogue will prove valuable to those interested in machinery, and can be obtained by addressing the company and mentioning Marine Engineering.

Coaling at Sea is the title of a handsome 9 by 6-inch catalogue issued by the Lidgerwood Manufacturing Company, 96 Liberty street, New York city. The catalogue describes the Lidgerwood-Miller marine cableway as installed on the U. S. battleship *Illinois* by the above-named company. It is stated that the first marine cableways were placed upon colliers, thus the necessary mechanism was carried on board the collier. Now, however, the system and machinery have been so simplified that but two winches are required, and these are placed on the battleship and are such as may be used for other purposes than coaling the ship. The only other deck space required is that for mounting two levers on the after bridge of the war vessel for operating the winches. The rest of the equipment consists of cables, special blocks, truck and carriage for carrying the coal from the collier to the ship. The capacity of this cableway depends largely upon the rapidity with which the bags can be filled and hooked to the lifting truck. In the tests on the English battleship 40 tons per hour were transferred, but the maximum capacity was not reached. A full description of this system and illustrations showing the method of attaching the marine cableway, with details of the parts, is given in this catalogue.

OUR PATENT

Six Inch Micrometer

will measure round work to 4½ inches and flat work to 6 inches. It weighs 21 ounces and is rigid and accurate.



IT is sold in a neat leatherette case, and is a most desirable instrument for every engineer and machinist to have. . . .

We send free to all engineers a copy of our fine tool catalogue, No. 16 L, with Supplement showing many new tools.

The L. S. STARRETT CO.

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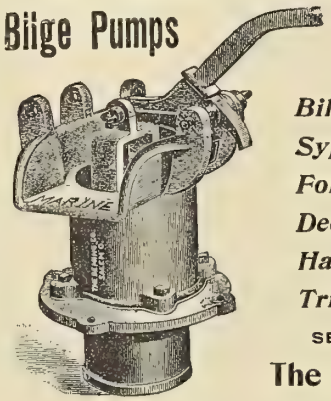

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Force Pumps,
Deck and other
Hand Pumps.
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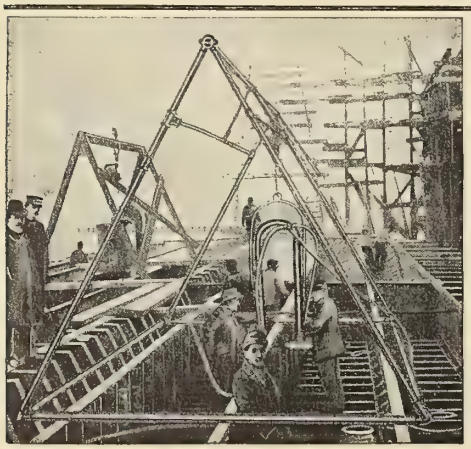

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JOSEPH DIXON CRUCIBLE COMPANY,
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WE have complete Drawings and Patterns of a.....

GAS ENGINE

The engine has been thoroughly tested, and has been found very efficient and economical.

We wish to get into communication with parties who will take an interest in the business of manufacturing this engine.

Full particulars given upon inquiry to

GAS ENGINE,

Care Marine Engineering, 309 Broadway, New York

A neat booklet is issued by Clarence P. Day, advertising counsellor, 140 Nassau street, New York city, describing concisely his advertising shop and his methods of handling the advertising of manufacturers and others who seek to extend their trade. The booklet gives much information which will interest every man who wishes to secure publicity and efficiency in handling his advertising.

List No. 25 of second-hand machine goods for sale by the Garvin Machine Company, Spring and Varick streets, New York city, is now being distributed, and an inspection of the list shows that second-hand drill presses, gang drills, forges and blowers, gear cutters, grinding and polishing machines, engine and hand lathes, milling machines, planers, presses and shears, screw machines and shapers can be bought from this company.

The Individual Advertising Department is the title of a 54-page book, 5 by 12 inches in size, issued by the Whitman Company, 116 Nassau street, New York city. The price of the book is given as "any kind of a dollar." The book is neatly printed in two colors and is a fine specimen of typographical work. This feature, however, is unimportant compared to the amount of common sense which is shown by the author. He evidently appreciates that a great deal of money is wasted in careless and inefficient advertising and the many ways in which men are "worked" who have money to spend for advertising. Any of our readers who have anything to do with the advertising of a mechanical business will find it a good investment to secure a copy of this booklet. If he does not find in it enough information to make it much more than worth the dollar which it costs, we can assure him that the Whitman Company will return his money.

Circular No. 24 of the Union Telpherage Company, with offices at 20 Broad street, New York city, gives a description of some of the new installations of overhead telpherage system made by this company. In one paper factory it states that not less than six million bags are transported in 10 hours. The speed of 12 miles per hour is obtained, and at 12 per cent. grade the speed is 6 miles per hour. The telpherage truck carries 4,000 pounds and there are a number of curves around which it must go. This speed is very high for transporting through a crowded factory and the amount carried is, indeed, large for one machine. The maintenance of the telpherage system is low. There are no moving parts except the telpher, which is perfectly clean, and no skilled labor is required. Power for operating the telpher is taken from an overhead trolley, and the current is returned by a second overhead wire. Circular No. 23 describes a cross-country line of telpherage cable tracks. The line, which consists of a cable and overhead trolleys, is supported on A-frames in such a manner that two lines can be run, one on either side of the support. It can be taken up or down hill, around curves, or wherever necessary.

WATCH THIS SPACE FOR OUR NUMEROUS SPECIALTIES.

WALWORTH MFG. CO. TOOLS and SUPPLIES for STEAM WATER and GAS USERS BOSTON MASS.

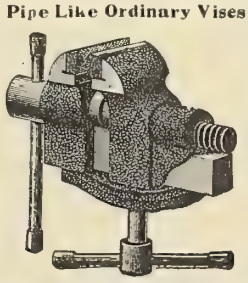
Walworth Extra Heavy Bench Pipe Vise

Is made especially for use in

MARINE REPAIR SHOPS AFLOAT AND ASHORE,

Grips pipe 1 to 6 inches inclusive, and by reason 8 of its solid and substantial "make up," also furnishes a first-class tool for general machine work.

Will not Crush or Jam Pipe Like Ordinary Vises



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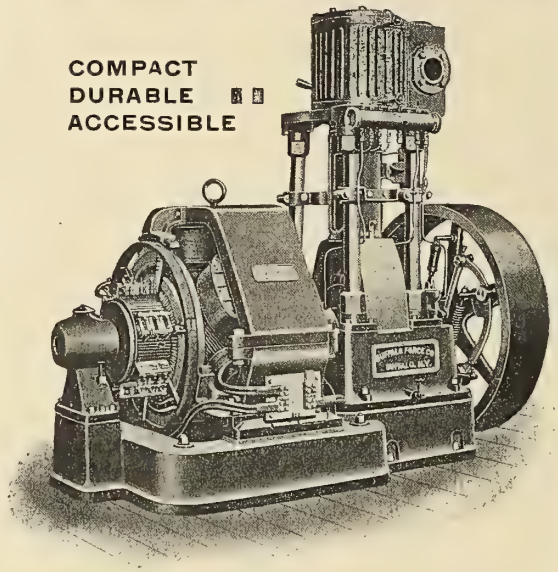
New York, Park Row Building. **WALWORTH MFG. CO.,** Boston, 128 Federal Street.

Write for our BLUE CATALOGUE "D." showing complete line of engineers' pipe fitting tools.

BUFFALO FORGE COMPANY ENGINES
FOR MARINE LIGHTING SETS

COMPACT
DURABLE
ACCESSIBLE



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NEW YORK BUFFALO, N. Y. LONDON, ENG.

A Little Good Kauri Gum

in refined linseed oil makes an excellent medium for grinding
ZINC WHITE
intended for use on metal.

ZINC WHITE

is essential for durable paint in white or tints, and a small percentage of good gum in the oil adds to its working qualities and enhances its beauty.

The New Jersey Zinc Co.
11 BROADWAY NEW YORK

FREE: Our Practical Pamphlets:
"Paints in Architecture," "The Paint Question,"
"French Government Decrees."

A new type of direct-connected generator, styled type MPL, has recently been turned out by the Fort Wayne Electric Works, Fort Wayne, Ind. The machine is a very handsome one throughout.

Electrical Tables, containing reference tables for wires for electrical purposes, have been issued by the American Steel and Wire Company, Chicago, New York, Denver, and San Francisco. Among the tables are those for the dimensions and weights of copper wire, comparative sizes of wire by different gages, weight of wire by different gage, tables of iron and steel wire, galvanized wire, weight of copper cables, weatherproof wire, etc., etc.

Power Plants of the Pacific Coast is the name of a very handsomely illustrated booklet, 8 by 10 inches, containing a paper read before the New York Electrical Society by F. A. C. Perrine, D.Sc. It is a description of several of the large water-power plants of the coast, and takes up the general features and conditions met with along the lines. Power is generated among the Sierra Nevada Mountains and carried 154 miles to San Francisco at the enormous voltage of 50,000 volts. Copies of this interesting paper, we presume, may be had by applying to the Standard Electric Manufacturing Company, Pittsfield, Mass.

Storage Battery Electric Locomotives have many advantages for general factory purposes. Among these claimed are that there is no risk of fire, there are no trolley wires to maintain, there is no electrolysis from return currents, and any part of the works where a 12-foot radius curve can be made can be reached by the locomotive. It is also cheaper to operate and maintain than a span of horses, and the machinery, if ever out of order, can be easily gotten at, as it is all above the car platform. The batteries are also above the platform and can be easily inspected. Locomotives of this type are made by the C. W. Hunt Company, West Brighton, Staten Island, New York, and described in a special circular.

Catalogues No. 5 and 6, just issued by the Garvin Machine Company, Spring and Varick streets, New York city, describes the milling machine attachments made by this company. This catalogue is well illustrated.

The Four-Track News is the title of an illustrated magazine of travel and education published monthly by the Passenger Department of the New York Central and Hudson River Railroad, Grand Central Station, New York city. There are some interesting, well-illustrated articles on the Home of the Caribou; the Wonders of Electricity; The Berkshire Hills, and many tales of camp and sporting life. This publication will be of value to those seeking for places in which to spend vacation times. The price per copy is 5 cents, per year 50 cents.

After fire destroyed the factory of the Abendroth and Root Manufacturing Company one year ago, it was decided to move the works to Newburg, New York. Circular E, issued by this company from the offices at 99 John street, New York city, announces that business has been resumed and the company is prepared to take orders for spiral riveted pipe, straight riveted pipe, exhaust heads, water-tube boilers, Wright engines, Dixon-Corliss engines, sheet-iron work, tanks, general foundry and machine work. Views of the works are given in this small circular, together with views of specimen pipes.

Valuable Booklets Free.—The Smooth-On Manufacturing Company, of Jersey City, has moved into new quarters. The offices are now at 547 and 549 Communipaw avenue and the works are at 53 and 55 Harrison avenue. In its new laboratories the company has the best apparatus for general chemical analysis. A new treatise on this subject has just been issued by the company. It shows deep knowledge, and the style is plain and simple. Another book describes the Smooth-On Iron compounds, Smooth-On paints, and Smooth-On cements for iron, steel, and brass. Both these publications are free for the asking.

BUSINESS NOTES.

Dry-docks.—H. I. Crandall and Son Company, engineers and contractors, East Boston, Mass., has recently secured two contracts for marine railways: one at Wolfville, N. S., and the other, a 3,500-ton steel cradle marine railway, for Hall Brothers, Port Blakeley, Wash.

Wilson and Silsby Sails in Germany.—The yacht *Uncle Sam*, which won the yacht race off Kiel, Germany, last month, was fitted with sails manufactured by Wilson and Silsby, Boston, Mass. This firm has furnished sails for a number of the best-known yachts in European waters, not only American owned yachts, but many owned by Europeans.

A Fine Catalogue Free.—Charles H. Besley and Company, 10-12 North Canal street, Chicago, Ill., report that there seems to be no general let-up in business, even though it is the middle of the summer. Many orders are received for Helmet babbitt metal, and large shipments are being made of their celebrated Helmet oil and Badger and Bonanza oil cups. Gardner grinders continue to be called for from all corners of the world. Any of our readers who are interested in the large variety of tools and other specialties manufactured by this company should send for a copy of the large and fine catalogue which is sent free to all inquirers.

Ship Berths.—Lein, Irvine and Company, 328 East Twenty-third street, New York city, are devoting a large part of their attention to making berths and berth fittings of all kinds. This firm manufactures eighteen styles for first, second, and third-class cabins, forecastle berths, etc. This company has been particularly successful in equipping army transports. Unless especially ordered otherwise. all berths which this firm fits are made of metal, thus affording not only strength and lightness, but assuring cleanliness. The company issues a compact and thoroughly-illustrated catalogue, which illustrates very fully the many types of berths manufactured, and describes concisely and briefly each type.

Metallic Packing.—One of the best endorsements that France metallic packing can have is that the manufacturer, A. W. France, Tacony, Philadelphia, has been compelled to engage an extra shift of men, and the works are now running twenty-three hours daily in an endeavor to keep up with the large and ever-increasing demands for this packing. Both domestic and foreign orders are received from companies who have tested this packing and found it to meet all requirements. In order to meet the demands of the trade, Mr. France advises us that he is now manufacturing high grades of fibrous packing of the best wearing qualities. Further information in regard to the prices, etc., will be sent upon application.

For Steam Making Refrigerating Apparatus

MECHANICAL THERMOMETERS

HOHMANN & MAURER MFG. CO. ROCHESTER, N.Y. TRADE H&M MARK

For All Engineering and Manufacturing Purposes

Write for Illustrated Catalogue M.

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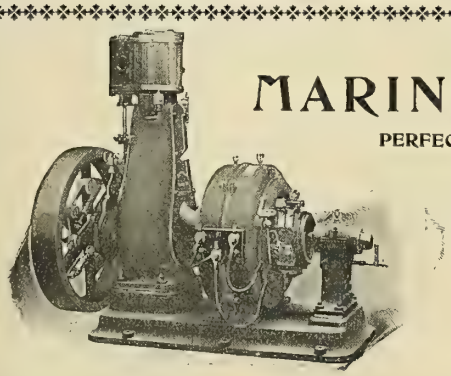
Infringement Suit Settled.—The Cleveland Pneumatic Tool Company, Cleveland, O., reports decision in its favor in connection with an infringement suit. The patents in question were in regard to a long-stroke hammer or hand riveter.

Resumption of Business.—C. J. Tagliabue, 53 Fulton street, New York city, maker and seller of thermometers, hypodermic syringes, and kindred articles, announces that, after undergoing a severe fire a few weeks ago which burned out his offices, he is now prepared to guarantee better service than ever before.

Electric Heaters.—The Simplex Electrical Heating Company, 77 Cornhill, Boston, Mass., has taken and will conduct the electric heating business which has been developed by the heating department of the Simplex Electrical Company. This change separates the electric heating business from the manufacture of insulated wires and cables, so that this part of the business can be carried on with a broader policy. Additional factory buildings are now under construction, which will provide more than three times the present capacity. The management will remain the same as heretofore. The principal office of the company will be at 77 Cornhill, Boston, although orders and correspondence can, if desired, be sent to the factory at 116 Franklin street, Cambridgeport, Mass. The Chicago office will remain in charge of H. R. Hixson, 1137 Monadnock Block. James I. Ayer remains as manager of the company.



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General Offices: 527-531 West 34th St., New York

Chicago: Fisher Bldg. Boston: Weld Bldg. St. Louis: Security Bldg. Baltimore: Maryland Trust Bldg.

For the South American Trade.—The Pittsburg Blue Print Company, Pittsburg, Pa., has recently appointed Señor Ernesto Thomas, of Santiago, Chile, to represent the company in the countries of Peru, Equador, Colombia, Bolivia, and Chile.

Change of Address.—The U. T. Hungerford Brass and Copper Company, New York, announces that, owing to the fact that the Rapid Transit Commission is about to build a subway station on this company's property, it will move to the new Hallenbeck building, corner of Pearl and Park streets, and occupy the basement, street floor, and first floor above the street. As soon as an adjoining building is completed the company will occupy similar floors in each, giving a total of about 3,000 square feet of floor space. Here will be carried in stock case goods, ammunition, and an immense stock of sample brass, copper, and kindred goods. Much of the space will be reserved for show-room purposes for other lines of goods. The offices and counting rooms will be located on the third floor.

New Ashton Agency.—The Ashton Valve Company, 271 Franklin street, Boston, Mass., has opened an agency in the Union Trust Company's Building, Baltimore, Md. The office will be in charge of W. R. Baldwin as special agent, who will carry a full line of Ashton pop safety valves, steam gages, etc., covering both the marine and stationary trade.

Pneumatic Tools.—The Philadelphia Pneumatic Tool Company, Philadelphia, Pa., has opened an office in South Africa, with headquarters at Johannesburg. This agency will be in charge of General Samuel Pearson, late of the Boer forces. General Pearson has been in the United States for some months in the interests of his Government, in the attempt to have the mule shipments from Port Chalmette stopped. Now that peace has been declared, he will return to his former business in machinery lines, and will handle the accounts of the Philadelphia Pneumatic Tool Company and others. Before coming to America, General Pearson saw much active service in the field, for a time in charge of railway traffic.

"BENEDICT-NICKEL" Seamless Condenser Tubes are the only tubes that are *not* readily effected by Electrolysis.

"Benedict-Nickel" is an alloy of nickel and copper. The tubing is stronger, tougher and denser than any other. By hot rolling a solid cylindrical billet upon a forming mandrel, it is made like a twist gun barrel.

Send for treatise, "Electrolysis of Condenser Tubes," which gives full scientific reasons for the superiority of "Benedict-Nickel."

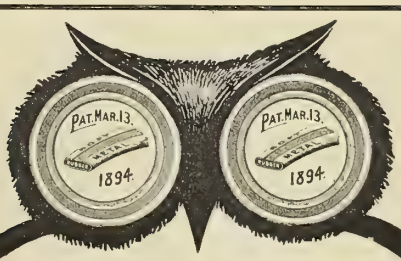
We are also large manufacturers of brass and copper tubing, made by the same process as "Benedict-Nickel," and of brass and copper sheets, wire, etc.

BENEDICT & BURNHAM MFG. CO.,
Main Office and Factory, Waterbury Conn.
New York, 253 Broadway. Boston, 172 High Street.

V. Waring, N.Y.

Bearing Brasses.—A letter written to Wm. A. Hardy, Fitchburg, Mass., by the superintending engineer of the Boston Steamship Company, states that the Hardy S. S. Metal has been used on all of the steamers of the Boston and Philadelphia fleet for seventeen years, and during that time it has given entire satisfaction. The feature of this metal is its marvelous durability, and the superintendent states that he regards it as the best metal ever used.

Classification of Vessels.—The following vessels have been recently classed and rated by the American Bureau of Shipping in the Record of American and Foreign shipping: American screw *Berkeley,* Am. screw *Atlantic,* Am. screw *Valencia,* Am. bark *Grace Deering,* Am. schooner *Harry L. Fenner,* Am. schooner *Gracie D. Buchannan,* Am. tern *H. E. Thompson,* Am. barge *Santiago,* British schooner *Glenrosa,* Br. tern *Unique,* Br. tern *Arthur M. Gibson,* Am. bark *Onaway,* and Br. barkentine *Athena.*



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Consulting Engineer.—John Haug, consulting engineer and naval architect, announces his removal from 206 Walnut street to 536 Bourse Building, Philadelphia. Mr. Haug was formerly ship and engineer surveyor to Lloyd's Register.

A Perilous Launch Trip.—The New York Kerosene Oil Engine Company, New York, evidently has perfect confidence in its engines, as one of its boats has just started on a trip across the Atlantic ocean. It is a 38-foot launch, navigated by Capt. Wm. C. Newman, whose only companion is a sixteen-year-old son. The launch is equipped with a 10-horse power engine, and it is understood that 600 gallons of kerosene are carried along as fuel. This engine is of the explosive type.

Pipe Covering.—The pipes in the plant of the Tesla laboratory, Wardenclyffe, Long Island, New York, were recently covered by the asbesto-sponge felted sectional pipe covering made by the H. W. Johns-Manville Company, 100 William street, New York city. The work has given satisfaction to the owner. The covering is made of fibers of asbestos and a small quantity of granulated sponge, thus combining the familiar properties of asbestos with the lightness and porosity of sponge.

Naval Architect Masters.—Arthur Masters, who has opened an office at 29 Broadway, New York city, as naval architect and marine engineer, was brought up in the shipbuilder's business. He served an apprenticeship in the yard of Sir W. G. Armstrong, Mitchell and Company, Newcastle-on-Tyne. Mr. Masters came to this country in 1890, and had charge of the construction of U. S. S. *Bancroft* at the Crescent shipyard. In 1893 he went to the yard of the Wm. Cramp and Sons' Ship and Engine Building Company and worked on the *St. Louis, St. Paul,* together with several naval and merchant marine vessels. In 1898 he made an extended trip through Europe, visiting shipyards, and, upon his return, became the leading draftsman in the Crescent shipyard. In addition to designing, Mr. Masters will do ship and engine surveying and a yacht and steamship brokerage business.

An Important Purchase.—It is stated that the Standard Roller Bearing Company, Philadelphia, Pa., has purchased the plant and equipment of the Roller Bearing and Equipment Company, Keene, N. H. This purchase, together with that of the Grant Roller Bearing Axle and Wheel Company, of Cleveland, O., will give the Standard Roller Bearing Company a large share of the roller-bearing business, both because of equipment and the patents held. The Standard Roller Bearing Company, owing to increased demand for its product and because of the expected removal of the Keene plant to Philadelphia, has purchased a large piece of land in that city and is about to erect a model factory 200 feet long and 150 feet wide. The property covers about 2 1-2 acres, and the buildings will be erected with a view of extending. The Hall Bros. Company, also of Philadelphia, recently removed from Boston, will occupy a portion of the new plant.

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BERLIN:—European Western Electrical Instrument Co., Ritterstrasse 88.
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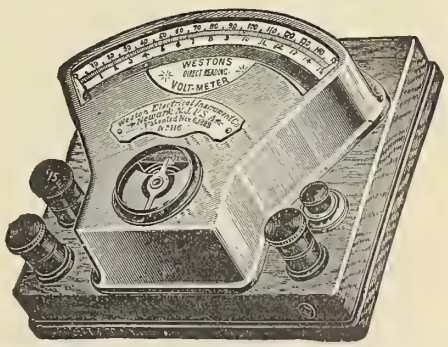

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SPECIAL NOTICES.

Announcements under this heading will be inserted at the uniform rate of thirty-three-and-a-third cents a line. Lines average ten words each.

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Position wanted as Loftsman or Foreman Fitter by steady, experienced man who understands yard and mold work thoroughly and who takes an interest in his work.

Address, LOFTSMAN,
Care Marine Engineering, 309 Broadway, New York.

Hand Motor for Boats.—The Prouty Manufacturing Company, 35 Oliver street, Boston, Mass., has placed on the market a hand motor for propelling small boats. The operator can face the bow of the boat and easily work the motor with one or two hands. The machine is located about the middle of the boat, and is driven by swinging backward and forward a vertical lever.

Certificate of Award.—A certificate of award and gold medal has been given by the judges of the South Carolina Interstate and West Indian Exposition to the Lake Shore Engine Works, Marquette, Mich., for the Superior marine engine manufactured by this company. The award was given because of "the simplicity of construction, sureness of action, perfection of build, and the large power developed in a minimum space and with minimum weight."

Many Awards Received.—The South Carolina Interstate and West Indian Exposition, which was closed on May 31, gave the American Steel and Wire Company, Chicago, ten gold medals, four silver medals, four bronze medals, each medal representing the highest award in each class. The various exhibits which drew the prizes were cold-drawn steel shafting, nails, horseshoes, wire-drawing machinery, wires made of different metals, bicycle and automobile spokes, trolley wire, music wire, coal and coke, chemicals and colors, etc.

A Fine River Boat.—The Mexican *Industrial Review* for June contains a complete and well-illustrated description of the river steamer *Dos Rios,* built by the Marine Iron Works of Chicago for service on a Mexican river. The boat has a length of 111 1-2 feet 6 inches over all and beam of 22 feet 8 inches. The average draft with ordinary load is 24 inches. The boat is propelled by two direct-acting, non-condensing engines, 9 by 48. The average steam pressure is 165, and the 12-foot paddle wheel makes 24 revolutions a minute. The boiler is of the Western river type and is designed to burn wood.

Brass and Malleable Unions.—As a result of experiments with substitutes for malleable iron pipe unions, the Western Tool Company, Kewanee, Ill., has placed on the market the Kewanee Ball Joint Union. This pipe connection will appeal to those who have been annoyed by leaky joints and worn packing. No gaskets are required for the Kewanee. In most joints where metal gaskets are used water-tightness cannot be maintained, because of the varying temperatures which create unequal expansion in the different metals employed. In the Kewanee union the brass part, which is the most sensitive to varying temperatures, is confined by a ring of malleable iron, screwed on at normal temperature until a tight seal is made.

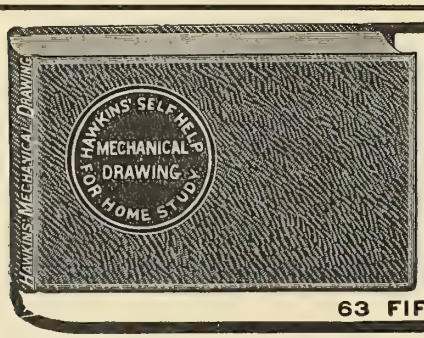
Change of Address.—The northwestern office of the Pennsylvania Steel Company is now located in the Western Union Building, Chicago, Ill., and in charge of Clifford J. Ellis, sales agent, and Robert E. Belknap, assistant sales agent.

New Factory.—The Cleveland Pneumatic Tool Company, Cleveland, O., has purchased a tract of land on Hawthorne and Second avenues, of that city, and will at once begin the erection of modern factory buildings. This enlargement was necessitated by increased business.

Ellis and Eaves Draft.—We are informed that the many installations of Ellis and Eaves draft which have been made on vessels built by the American Shipbuilding Company on the Great Lakes by representatives of John Brown and Company, Sheffield, England, are in very successful operation. In two weeks the shipbuilding company booked orders for seventeen new steamers, seven of which are to have Ellis and Eaves draft and ten natural draft.

Emergency Accident Case.—A very convenient and useful emergency accident case, called the No. 10, has been placed on the market by the Adolph Levy Company, 127 East Twenty-third street, New York city. The case includes several ready-made field dressings, various other kinds of bandages and dressings for wounds, septic and antiseptic dressings, etc. This case is in extensive use throughout the United States, on board ships, in factories, mines, machine shops, etc. A valuable addition is a printed bandage upon which are illustrated the methods of bandaging wounds in various parts of the body and how to set broken bones, etc.

Babcock and Wilcox Boilers.—The following quotation from the report of the committee appointed by the Lords Commissioners of the British Admiralty to consider certain questions respecting modern types of boilers for naval purposes may be of interest: "In the course of their investigations the committee have watched the Babcock and Wilcox boilers fitted in the S. S. *Martello,* of the Wilson Line, employed in the Atlantic trade between Hull, Boston, and New York, and copies of the reports of their inspections have from time to time been forwarded to their Lordships. These inspections have taken place at the end of every round voyage for fourteen months, and the committee's opinion is that these boilers have stood the test of usage in the mercantile marine extremely well. The vessel has run about 91,000 miles since the boilers were put in, and has usually been less than a week in port at either end; the only repairs required have been those of the ordinary upkeep of any boiler, such as fire bars, brickwork, etc., and only six tubes have required renewal. This opinion is strengthened by the inspections of boilers of the same type fitted in the *Numidian,* the *Buenos Ayrean,* and the *Turret Cape.* In the case of the last-named vessel, the boilers have been in use seven years and cannot have been as well looked after as they would have been in the Navy, and their condition when examined recently was satisfactory. The committee have also examined and tested boilers of the same type in H. M. S. *Sheldrake,* and find that, although they have been in use for four years, their condition is good and they have given little trouble."



Learn to Draw. This book, as shown in illustration is a self-instructor for home study and practice in the art of Mechanical Drawing for Engineers, Machinists, Electricians, Metal Workers and all interested in Drafting for shop practice, and has been prepared in plain practical language, and illustrated, by the author of "Hawkins' Educational Works." The book is divided into 28 different subjects which comprise the fundamental principles of drawing, each heading being thoroughly treated. There are 320 pages, 300 illustrations and diagrams. The book is handsomely bound in green cloth, gold edges and titles, size 7 x 10½ in., printed on fine paper. Upon receipt of $2 the book will be sent to any address prepaid, money returned if not as represented, order to-day; see order coupon.

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" 2, George Averill, 296 Archwood Ave., Cleveland, O.
" 3, A. L. Jones, 289 Champlain St., Detroit, Mich.
" 4, Jas. A. Macauley, 5802 Michigan Ave, Chicago, Ill.
" 5, Otto Boettger, 1035 E. Hopkins Ave., Baltimore, Md.
" 6, Clifford E. Shrodes, Room 13, Railroad Exchange, 110 North Fourth St., St. Louis, Mo.
" 7, B. J. Holmes, 191 Coyle St., Portland, Me.
" 9, Wm. Bridges, 784 1-2 12th St., Milwaukee, Wis.
" 13, Wm. V. H. Sheer, 1129 Venango St., Philadelphia, Pa.
" 15, O. J. Lewis, 322 Deloronde St., New Orleans, La.
" 17, Francis S. Neal, Section Ave., Norwood, O.
" 18, Wm. Hurst, 715 Walnut St., Cairo, Ill.
" 20, Jos. B. Barry, 206 Keel St., Memphis, Tenn.
" 23, W. R. Lewis, 213 East Front St., Jeffersonville, Ind.
" 24, Jos. B. Flach, 327 N. Fourth St., Paducah, Ky.
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" 38, W. H. Collier, 73 Starr Boyd Building, Seattle, Wash.
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" 40, S. P. Mallia, 1028 Market St., Galveston, Tex.
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" 45, Jas. A. Rourke, 708 East Bay St., Savannah, Ga.
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" 47, Norman Raines, 804 East Spruce St., Sault Ste. Marie, Mich.
" 48, Carl V. Hart, 425 Perry St., Sandusky, O.
" 51, Henry Connell, 28 Yuba St., Muskegon, Mich.
" 53, Harry Stone, Marine City, Mich.
" 55, Archie Stalker, Electric Light & Power Plant, Cheboygan, Mich.
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" 94, George R. Jones, Box 222, Washington, D. C.
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" 101, Thos. J. Hanlon, Box 765, Norfolk, Va.
" 102, Fred W. Linsemeyer, 210 Clinton St., So. Haven, Mich.
" 103, Herbert Parkins, New Berne, N. C.

TRADE PUBLICATIONS.

The International Sprinkler Company, Philadelphia, Pa., is sending out an 8-page folder, giving the lists of the installations of this system in factories, shipyards, wharf buildings, and large establishments of various kinds all over the country.

A supplement has been issued by the L. S. Starrett Company, Athol, Mass., to this company's Catalogue No. 16 of fine mechanical tools. Among the new tools described in this catalogue are: measuring tapes and rules of various kinds, universal dividers, screw-pitch gages, punches, gages and micrometers of many kinds, hack saws, clamps, levels for testing shafting, etc.

"Galvanum," a Paint that Will Adhere to Galvanized Iron, is the title of a catalogue now being distributed by the Goheen Manufacturing Company, Canton, O. A great deal of information is given regarding the painting of metal surfaces, and many illustrations are shown of boats, steel structures, and other metal surfaces protected by this paint. Users of paint for metal surfaces will find a copy of this catalogue of interest.

The subject of Calorimeters is very completely covered in a pamphlet written by Prof. R. C. Carpenter and issued by the Schaeffer and Budenberg Manufacturing Company, Lee Place, Edwards and Bedford streets, Brooklyn, N. Y. The catalogue comprises 34 pages and takes up, each in turn, the throttling calorimeter, a new form of steam calorimeter, and the improved coal calorimeter. There is also a table giving the properties of saturated steam in much detail, and a page devoted to discussing the importance of determining the importance of moisture in steam.

Two catalogues of machine tools are now being distributed by the Garvin Machine Company, Spring and Varick streets, New York. Catalogue No. 3 is devoted to vertical milling machines, profilers, and duplex milling machines. It is well illustrated with good wood cuts, and, as it comprises 24 pages 6 by 9 inches in size, its value can be readily appreciated. The other catalogue is No. 8, and is devoted to screw machines, monitor lathes, forming machines, and double-turret screw machines. It is the same size as the other and is equally as well printed. It comprises 28 pages.

Pressure and volume blowers, as manufactured by the American Blower Company, Detroit, Mich., are fully illustrated and thoroughly described in a handsome catalogue, known as Catalogue No. 41, which is now ready for distribution. The catalogue is finely printed in two colors on coated paper. Each blower is illustrated with fine engravings, many of them being half-page or more in size. In addition to the engravings showing the blowers complete, many pictures are given of the different parts with the blowers taken asunder. There are also sectional views, together with many tables of dimensions, speeds, capacities, horse powers, etc. In addition to those direct-connected to electric motors, there are blowers belted and direct-connected to steam engines. There is much information also regarding subjects kindred to the operation of blowers, so that the catalogue is made very valuable to any one at all interested in the subject.

Liquid Fuel, Its Advantages for Shipyards and Manufacturing Plants, is the title to an excellent catalogue now being distributed by W. M. Simpson and Company, Old Colony Building, Chicago, Ill. It comprises 32 pages, neatly printed in two colors. The first device described is the Ferguson portable heater, which was illustrated and described in MARINE ENGINEERING for May, 1902. This heater is designed especially for flanging and working boiler plates, straightening corrugated furnaces, heating laps, building up crank shafts, removing shaft couplings, taking off propellers, heating bent beams and plates for straightening, and much other such work. A number of full-paged illustrations are given showing the use of the heater for this purpose. Several pages are devoted to the discussion of "Oil as Fuel," giving much valuable information. Other types of Ferguson oil furnaces are also described, including rivet furnaces, forging furnaces, angle furnaces, and annealing furnaces.

The Brass Founders' Supply Company, 20-34 Prospect street, Newark, N. J., is now distributing Catalogue No. 11. The catalogue covers thoroughly all the modern equipment for a brass foundry. It is fully illustrated, and with complete reading and descriptive matter, tables of sizes, dimensions, etc., prices and other information, the catalogue is made very valuable to any one who has to do with brass foundry work.

Users of hoists will want to send for a copy of Bulletin No. 209, which is now being distributed by the Sprague Electric Company, 527 West Thirty-fourth street, New York. This bulletin is devoted to electric trolley hoists of various kinds which this company manufactures. They include hoists of almost every size, such as would be used in engine rooms or in wharf and warehouse buildings, to the very largest used in engine shops, shipyards, etc. The pages are 7 by 9 inches in size, and on nearly every other page is a page-size cut, so the hoists are well illustrated.

The Underfeed Stoker Company, whose New York office is 149 Broadway, is distributing a very complete catalogue of about 90 pages which will interest every user of steam. To begin with, it is a neat specimen of printing and is illustrated thoroughly. The stoker which this company manufactures is shown in all conditions and positions, and explained to the utmost detail. The catalogue is 6 by 9 inches in size, and, as most of the pictures are full page, the value of the catalogue can be readily appreciated. Many letters are given in the back part of the catalogue from users of the stokers, speaking of them in the highest terms.

The New York Rapid Transit Tunnel is very handsomely illustrated and thoroughly described in a catalogue which is being distributed by the Rand Drill Company, 128 Broadway, New York. So many pictures are given in the catalogue and they are so large that a much more complete idea of the extent of this great work can be had from this book than from inspecting the tunnel itself The book is published as "illustrating the use and application of the Rand drills and Rand air compressors in centralized air-power plants." A perusal of this book will quickly impress the reader with the fact that the success of the subway is due very largely to the value of compressed air for drilling and such purposes.

The Monarch Automatic Engine Stop, being a description with illustrations of the Monarch system of automatic safety devices for use on steam and electric motors, is the title of a very handsome catalogue issued by the Consolidated Engine Stop Company, 100 Broadway, New York. The catalogue is handsomely issued in two colors on coated paper, and is bound in heavy dark-green paper cover. The pages are 8 by 10 inches in size, and there are more pages of illustrations, full-page size, than of reading matter. Altogether there are 32 pages. The stop in its complete form is first shown, and then there are sectional views and pictures of the stop as attached to engines, so as to show its application and manner of operating. Every engineer will find a copy of this catalogue well worth careful perusal.

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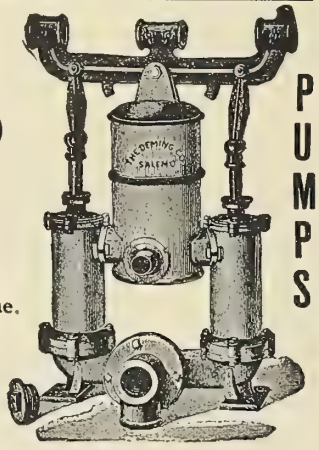

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The Starrett High Speed Indicator

which tells the exact truth about a shaft's revolutions. The working parts of this Indicator are encased, and the dial plate has two rows figures, reading right or left, as the shaft may run.

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applied to all our Indicators is the use of **Rubber Tips** for pointed or hollow centers on the hardened steel pointed spindles.

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No. 16 L of 112 pages with Supplement just issued, which tells of all the STARRETT TOOLS.

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A Knock-Down Argument

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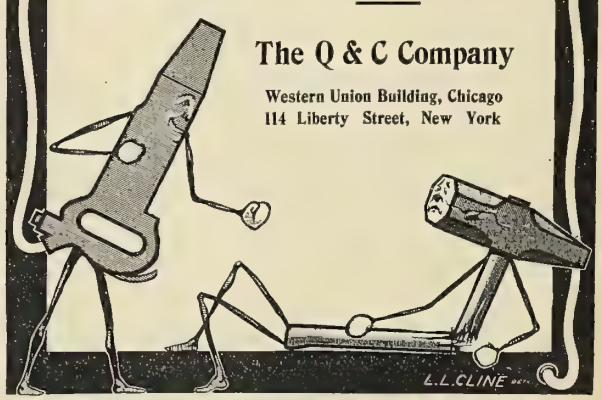
114 Liberty Street, New York



THE reason Dixon's Pot-Lead is the best treatment for the hulls of yachts, launches and other fast craft is because of its perfect smoothness. It offers less friction to the water, and every bit of friction means loss of speed. We have had seventy-five years of experience in the manufacture of graphite products. Our Pot-Lead, like our other products, is the best form of graphite for its purpose. Send for circulars.

JOSEPH DIXON CRUCIBLE COMPANY,
JERSEY CITY.

A Good Story and A Valuable Book **FREE**

"THE PROFESSOR ON SHIPBOARD"

to every subscriber of Marine Engineering who will send us a new subscriber and remit the price, $2.00 Domestic, $2.50 Foreign.

The price of the book alone is One Dollar.

Marine Engineering,
309 Broadway, New York.

The Buffalo improved ventilators were fully described in a neat catalogue issued some time ago by the Buffalo Forge Company, Buffalo, N. Y. There was such a demand for this catalogue that the entire edition was soon exhausted and another edition has now been printed. The catalogue is 3 1-2 by 6 1-2 inches in size, and is typical of the excellent publications issued by this company.

The Fort Wayne Electric Works, Fort Wayne, Ind., are distributing two new catalogues 8 by 10 inches in size. One of them is devoted to switchboard watt-meters and the other to enclosed direct-current series arc lamps. This catalogue is well printed and thoroughly illustrated, and made to conform to the other catalogues of this company, so that they can be readily bound.

Theo. Audel and Company, 63 Fifth avenue, New York, are distributing a booklet telling very thoroughly of the new book which this firm has just issued, entitled "Automobiles." The price of the book is $5. This pamphlet gives the table of contents of the book and reproduces many illustrations and pages, so that the reader can get an excellent idea of the quality and value of the book.

Fire Hose is the subject of a folder being distributed by the Boston Belting Company, 256 Devonshire street, Boston, Mass. Two kinds of hose are referred to: cotton-mill hose, which is described as rubber-lined, light, strong, durable, and waterproof, and which is credited with many other good features; the other is linen hose, which is unlined but is extensively used where it is necessary to keep hose hung up in dry places to be used in case of fire.

BUSINESS NOTES.

MUSICAL INSTRUMENTS.—Special air whistles, which are claimed to be the only four-tone, adjustable, single-bell, air-chime whistle, for use on naphtha and electric launches, or wherever an air whistle is required, are manufactured by the Kinsley Manufacturing Company, Bridgeport, Conn. These whistles produce four tones, pitched to a musical scale, giving an agreeable and melodious sound, and can be heard much farther than a common whistle. The bell is seamless brass tubing, readily raised or lowered to conform to any pressure used. The whistle can be operated by a hand air pump or air supplied from a tank. It requires but little air to blow it. The company furnishes a powerful hand air pump when required, capable of operating a 1 1-2-inch to 3-inch diameter whistle. The whistle, suitably piped, can be placed on the roof of the pilot house or at any point within 20 feet of the pump, the latter being of sufficient capacity to produce long, loud blasts on the whistle.

WATCH THIS SPACE FOR OUR NUMEROUS SPECIALTIES.

WALWORTH MFG. CO. TOOLS and SUPPLIES for STEAM WATER and GAS USERS BOSTON MASS.

"RUFF and TUFF" Dies

ARE MADE FROM THE FINEST GRADE OF TOOL STEEL TEMPERED BY EXPERTS.

They will Outlast the Ordinary Dies Several Times, Especially on Hard Steel Pipe, and Cost Only a Trifle More Than Common Dies.

Made in sizes to Fit any Solid Die Stock. It Will Save You Money and Patience to Specify "Ruff and Tuff."

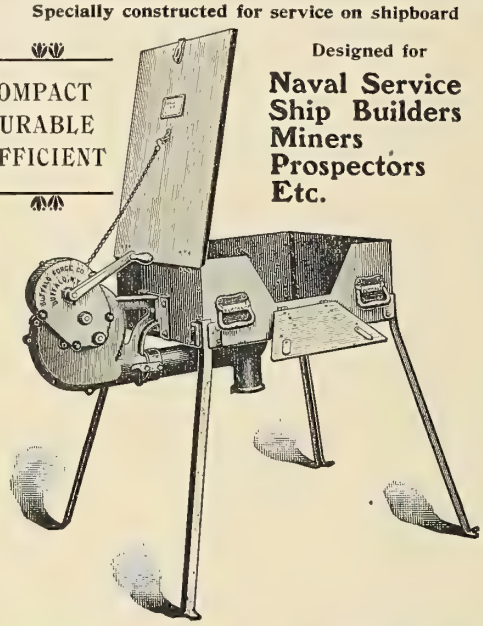
JOBBERS SELL THEM—IF YOURS DON'T, WRITE.
New York, Park Row Building. **WALWORTH MFG. CO.,** Boston, 128 Federal Street.
Write for our BLUE CATALOGUE "D." showing complete line of engineers' pipe fitting tools.

BUFFALO FOLDING FORGES

Specially constructed for service on shipboard

COMPACT
DURABLE
EFFICIENT

Designed for
Naval Service
Ship Builders
Miners
Prospectors
Etc.



Buffalo Forge Company
BUFFALO, N. Y., U. S. A.

WATER

Whether salt or fresh, tries paint more severely than the other elements; therefore ship builders use

ZINC WHITE

exclusively when white paint or tints are required for finishing their products. Marine work demands zinc white, because it is the only white pigment that will stand the service.

FREE: Our Practical Pamphlets
"The Paint Question"
"Paints in Architecture"

THE NEW JERSEY ZINC CO.
11 Broadway
New York

BAXTER D. WHITNEY AND SON.—Notice is sent out by Baxter D. Whitney, Winchendon, Mass., that he has formed a co-partnership by taking his son, William M. Whitney, into business with him. From this time on the firm will be Baxter D. Whitney and Son. The same business principles which have ruled from the founding of this plant over sixty years ago will remain in force, and the new firm will continue to progress as heretofore and manufacture a line of woodworking machinery of the highest grade.

MARINE PAINTS.—Samuel J. Williams, 11 Broadway, New York, announces that he carries everything in the line of paints and painters' supplies that would be called for in marine work. Mr. Williams manufactures the well-known Williams Submarine Paint, the Williams Copper Paint, the Williams Seam Paint, and the Williams Wood Anti-Fouling Paints. In addition, he has everything in the line of white lead, zinc, and the various colors.

BUFFALO FORGE GOODS.—The products of the Buffalo Forge Company, Buffalo, N. Y., are in steady demand throughout not only the United States, but European countries. The following list gives a few of the orders recently received through their different branch houses: Two 70-inch steel-plate steam fans for heating and ventilating, direct connected to two Buffalo engines, and one 130-inch standard steel-plate fan for mechanical draft to Copenhagen, Denmark. One induced draft plant and one 23-H.-P. engine for electric light plant in Dutch Guiana, South America. Five Buffalo engines of 45 H. P. each for driving generators, and one 38-H.-P. engine for a pumping equipment for a sugar factory in Cuba. One 20-H.-P. Buffalo engine to Germany. One 15-H.-P. Buffalo engine to Gothenburg, Sweden. One 60-inch standard steel-plate fan to Glasgow, Scotland. One 140-inch steel-plate fan to Barrow-in-Furness, England, together with other shipments to London and Manchester, England; Victoria, British Columbia; Halifax, N. S.; Portland, Oreg.; San Francisco, Cal.; New Orleans, La., etc.

A $10 BARGAIN

We have on hand only a few sets of MARINE ENGINEERING, as follows:

1899, Vols. III–IV; 1900, Vol. V;
1901, Vol. VI;

bound in black cloth with leather corners and back.

The price for the set is $10.00.

The price per volume is **$4.00.**

Floor space in offices on Broadway costs so much that we shall not attempt to keep complete volumes or back numbers of the magazine any longer, and while the sets last we will sell them for **$10** complete, carriage to be paid by the purchaser. No reduction in price for single volumes.

The period 1899–1901 marks a turning point in the history of shipbuilding in this country, hence these volumes are of great historic as well as technical value.

MARINE ENGINEERING
309 Broadway, New York

Large Gas Engines.—The Mianus Motor Works, Mianus, Conn., have been considerably enlarged, so that the company can manufacture not only more gas engines, but engines of large size. The company now manufactures, in addition to a complete line of gas engines for launches, oyster boats, and other craft, hoisting and pumping machinery.

Free Samples of Metal Polish.—George Wm. Hoffman, 295 East Washington street, Indianapolis, Ind., reports a greater demand than he has ever before experienced for his U. S. Infallible Metal Polish. This polish is sold either in powder or fluid form or as paste. The steadily increasing demand for this polish is because of its having been on the market many years, proving its value. In order to demonstrate that this polish is particularly adapted for use on vessels of any kind, Mr. Hoffman will send a sample box to any reader of Marine Engineering who will write for one.

Philadelphia Pneumatic Tools.—The Philadelphia Pneumatic Tool Company, Philadelphia, Pa., reports an unprecedented rush of business, and its manufacturing capacity is taxed to the utmost, running night and day to keep up with orders. The increasing demand for the Keller rotary drill is a particularly noticeable feature in this company's business. Four of the large Eastern steel companies have recently purchased Keller tools to the aggregate number of 237. One of the Western trunk-line railroads has recently made a contract with the Philadelphia Pneumatic Tool Company to purchase at least 1,500 Keller tools within the next eight months. A cable order for Keller tools was received last week from Bilbao, amounting to several thousand dollars. The business of this company has increased so enormously that it is understood that the capital stock is to be raised to $2,000,000, in order to take proper care of the rapidly-growing business and to push sales in all parts of the world.

Sanitary Systems for Yachts.—John D. Moore, 45 Liberty street, New York, has purchased the Hermes sanitary system for steam yachts and is now prepared to install it on vessels of any kind. A circular regarding this system, issued by Mr. Moore, states: "The annoying and disagreeable feature of a yacht is the plumbing. Expensively-built and luxuriously-furnished yachts are fitted with plumbing which would never be allowed in a house. It is so unsanitary and troublesome that it would not be tolerated by the Board of Health in the poorest dwelling ashore. The Hermes system is of modern scientific invention. It gives the yachtsman afloat better sanitation than he has in his home. It can be worked by a child as perfectly as by the strongest man. With it there is no restriction of the comforts of the bath or dressing room. Perfect cleanliness and sweetness are assured, as it immediately and automatically discharges overboard every particle of refuse matter. Some of the best yachts, like the *Corsair,* the *Nourmahal,* the *Aphrodite,* the *Virginia,* find it a benefit."

For Steam Making Refrigerating Apparatus

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Write for Illustrated Catalogue M.

NEW YORK 85 Chambers Street
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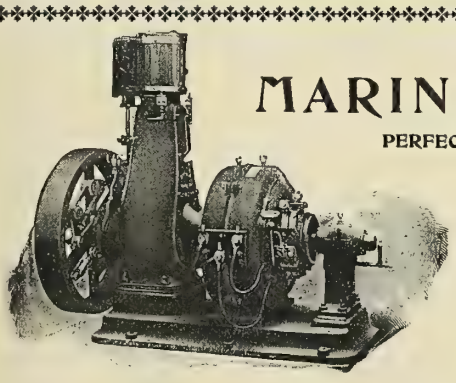
For All Engineering and Manufacturing Purposes

Sending Sails to Australia.—Reference was made in these columns recently to orders for sails sent from Australia and New Zealand to Wilson and Silsby, Boston, Mass. So many of the yachts fitted with these sails have won races that Wilson and Silsby continue to receive orders from that distant corner of the world, an order having just been received from West Australia.

Paint to Protect Steel.—In a paper recently read before the New York Railroad Club, W. S. Morris, in discussing the subject of painting steel, made the following statement: "It is presumed that those handling steel have by this time come to the realization that protection from weather and acid attacks is necessary. It may not be generally known that some forms of lead paint swell in the presence of sulphur, and, in swelling, increase in volume about one-third, thus tending to peel off. It seems to me that the parts of steel exposed to sulphur or sulphurous smoke ought to be painted with graphite and purest linseed oil, the inert graphite tending to protect the steel, perhaps on account of the minute flakes lapping over one another like the shingles on the roof of a house." The Joseph Dixon Crucible Company, Jersey City, N. J., manufactures a paint covering exactly the points made by Mr. Morris. This paint is known as Dixon's Silica Graphite Paint, which has been used for many years, not only in railroad work, but on steam vessels, wharf buildings, etc.



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MARINE GENERATING SETS

PERFECT SERVICE. LEAST SPACE, WEIGHT AND ATTENTION.

The design and construction of our apparatus are based on scientific principles resulting in unusually high efficiency and remarkable endurance under the most exacting conditions of service, and giving the best possible commercial value. Send for Bulletin No. 10115.

SPRAGUE ELECTRIC COMPANY

General Offices: 527-531 West 34th St., New York

Chicago: Fisher Bldg. Boston: Weld Bldg. St. Louis: Security Bldg. Baltimore: Maryland Trust Bldg.

SPRAGUE COMPANY ORDERS.—The Sprague Electric Company, 527 West Thirty-fourth street, New York, is achieving much success in securing many important contracts for its motors and generators, and both its factories are rushed to the utmost. In addition to its foreign orders and many orders for small-size apparatus, it has recently made sales in Hannibal, Mo., seven 35-H.-P. motors and eight 15-H.-P. motors; Northampton, Pa., one 30-H.-P. motor and two 35-H.-P. motors; New York city, fifteen 10-H.-P. motors, seventeen 25-H.-P. motors, and one 50-H.-P. motor; Wellston, O., one 300-K. W. belted generator, one 230-H.-P. motor, and six smaller motors; Kansas City, three generators; Brooklyn, one 150-K. W. split-pole engine-type generator; Washington, D. C., contract for ventilating plant, including one 5-H.-P. motor and one 10-H.-P. motor, two 15-H.-P. motors, and eight 20-H.-P. motors, together with many other orders calling for about seventy-five motors and generators, a dozen or so hoists, and other apparatus.

ORDERS FOR BOATS.—The Greenport Basin and Construction Company, Greenport, L. I., advises us that it has received a contract for two 30-foot and two 21-foot launches complete with engines, boiler, and pumps; two 30-foot sailing pinnaces, four 24-foot cutters, two 23-foot gigs, two 15-foot dinghys, to be used on the two Mexican gunboats now under contract at the Crescent Shipyard, Elizabeth, N. J. All the engine and boiler work will be done at the company's machine department, the Greenport Engine and Machine Company.

CHANGE OF LOCATION.—Westinghouse, Church, Kerr and Company announce the removal of their New York office from the Havemeyer Building, 26 Cortlandt street, New York city, to the Maritime Building, 8 to 10 Bridge street, opposite new Custom House and near Bowling Green. The change is the result of a largely increased business. Three floors, the first, second, and third, will be devoted to their uses. The new quarters will afford about double the floor space available in their present location.

"Benedict-Nickel"
Seamless Condenser Tubes
Resist Electrolysis
"BENEDICT-NICKEL" Seamless Condenser Tubes are the only tubes that are *not* readily effected by Electrolysis.
"Benedict-Nickel" is an alloy of nickel and copper. The tubing is stronger, tougher and denser than any other. By hot rolling a solid cylindrical billet upon a forming mandrel, it is made like a twist gun barrel.
Send for treatise, "Electrolysis of Condenser Tubes," which gives full scientific reasons for the superiority of "Benedict-Nickel."
We are also large manufacturers of brass and copper tubing, made by the same process as "Benedict-Nickel," and of brass and copper sheets, wire, etc.
BENEDICT & BURNHAM MFG. CO.,
Main Office and Factory, Waterbury Conn.
New York, 253 Broadway. Boston, 172 High Street.
V. WARING, N.Y.

POSITION OR PARTNERSHIP WANTED.

A SHIP AND ENGINE BUILDER, with a thorough experience in all branches of the business, both theoretical and practical, is desirous of opening negotiations with persons anxious to engage the services of a strictly first-class man, either to start a new yard of the most advanced type, or with a view to developing an established plant along the lines of the most economical policy known to American shipbuilding. Experienced in all types of steamships, including battleships, cruisers, torpedo-boats, Atlantic liners, yachts, etc., and particularly equipped for the construction of cheap and economical freighters and tramp steamers.

As an evidence of good faith I am willing to invest $20,000 with my services in a promising concern that will bear the strictest investigation. No small offers considered.

Address, "MANAGER OF SHIPYARD,"
Care Marine Engineering, 309 Broadway, New York.

A Word to the Wise

"McKIM GASKETS"

The long-wear kind. Made of packing encased in soft annealed copper.
Can be reapplied indefinitely.
Big and little—for manhole, handhole and pipe fittings.
One grade—the best we can make.
Prices and catalog on request.

McCord & Co.

104 Broadway, New York
1471 Old Colony Bldg., Chicago

CLEVELAND PNEUMATIC TOOLS.—The plans for the new plant of the Cleveland Pneumatic Tool Company, Cleveland, O., are completed. The company has just opened up an office at 411 Park Building, Pittsburg, Pa., represented by Charles L. Nelson, and at 34 Lemoine street, Montreal, Canada, represented by N. J. Holden and Company. The contracts for the new plant have been awarded to J. A. Reaugh & Son, Cleveland, O. It is expected to have the plant completed and ready for operation in October. The plant will be equipped with the most modern machinery and appliances for turning out the largest amount of work in the shortest time.

THE MONTAUK STEAMBOAT COMPANY.—The Montauk Steamboat Company, Ltd., Long Island City, New York, which operates steamboats between New York city and the eastern end of Long Island, reports the most satisfactory season in the history of the company. This trip is one of the most popular trips out of New York, as the boats run along the north shore of Long Island the entire length of the island. The trips are so arranged that they can be taken one way by daylight and return by night. This company also runs steamers to Block Island, where connections are made with Providence and Newport, and at Greenport connection is made by steamer with New London.

TECHNICAL ADVERTISING.—R. D. Lillibridge, who opened an office at 20 Broad street, New York, two years ago as Systematist and Advertising Manager, has moved to larger and more complete quarters at 170 Broadway, where he announces that he is now fully equipped to handle technical advertising. In a circular announcing his removal, he states: "The real advertising manager takes care of advertising in its entirety; circulars, catalogues, trade papers—all. Yet few businesses need, or can consistently afford, the undivided attention of a good advertising manager; therefore their advertising manager may just as well be employed by other non-competitive concerns, provided enough clerical assistance is available to turn out all the work satisfactorily."

VESSELS RECENTLY CLASSED.—Among the vessels classed and rated by the American Bureau of Shipping in the "Record of American and Foreign Shipping" recently are: American screw *Kroonland,* American barkentine *Emita,* American schooner *Perry Setzer,* American screw *San Jose,* American schooner *M. C. Haskell,* American three-mast schooner *Charles H. Wolston,* American three-mast schooner *Jennie S. Hall,* American three-mast schooner *Herald,* American three-mast schooner *Ann J. Trainor,* American three-mast schooner *C. C. Wehrum,* American three-mast schooner *Alice Lord,* American three-mast schooner *Alice M. Davenport,* American three-mast schooner *William T. Moore,* British schooner *Malden,* British schooner *Eduardo,* British screw *Ferrona,* British three-mast schooner *Strathcona,* British three-mast schooner *Damaraland,* and Swedish bark *Dan.*

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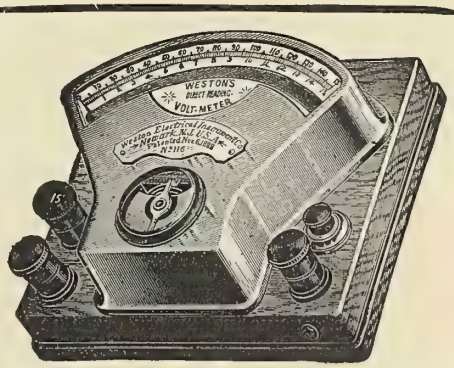
Voltmeters, Ammeters, Millivoltmeters, Voltammeters, Milliammeters, Ohmmeters, Portable Galvanometers, Ground Detectors and Circuit Testers.

Our Portable Instruments are recognized as **the standard** the world over. Our **Voltmeters** and **Ammeters** are unsurpassed in point of extreme accuracy and lowest consumption of energy.

WESTON ELECTRICAL INSTRUMENT CO.,
Waverly Park, Newark, N. J., U. S. A.

BERLIN:—European Western Electrical Instrument Co., Ritterstrasse 88.
LONDON:—Elliott Bros., 101 St. Martin's Lane.



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United Marine Mfg. & Supply Co.

Manufacturers of and Dealers in

ELECTRICAL MATERIAL

For Ships and Fortifications

ALBERT C. JAHL
General Manager

100 William St., New York, U. S. A.

The Matter of Lubrication.—It is within the memory of the youngest of us that the old-time tallow cup, made by a well-known house of Philadelphia, Pa., was almost the sole device for feeding tallow (which was the proper thing at that time) to valves and cylinders of marine engines, and gave satisfaction as far as it went. Twenty years ago there were very few sight-feed lubricators to be found on marine work around the harbor of New York. Of course there were a few double connection, and more recently an improvement by two single-connection designs, and a few of these first single-connection cups are still to be found in use among the tugs, but later the Couse flush method single-connection sight-feed lubricator, devised and patented by Charles Couse, then owner and engineer of the *John S. Stevens,* which was well known as one of the big-little boats of the time, came on the market. It is needless to say that it was a go, even at the price, which was $35 for pints and $45 for the quart sizes. It was sold on its merit and was a winner from the start. It was not long before it seemed as though almost every boat in the harbor had a Couse lubricator, and they are still going on, as the records will show. At the start it immediately found its way from one tug to another, and it is safe to state that no other small labor-saving device (for it was labor to keep punching tallow into an engine every few minutes) probably ever made more friends among the engineers and held them longer than the Couse flush method sight-feed lubricator. Our navy has adopted them as well as our merchant marine. Many of the same patrons and engine builders who purchased them from the start are still using them. Among the many reasons why the Couse cup has been so particularly successful among marine engineers is the fact that it is a single-connection cup, and the claim is also made that it is a single-connection cup that is absolutely reliable. On account of its construction it is exceptionally convenient for the marine engine room, which is generally limited in space. The one connection places the lubricator where it is most easily reached and directly under the eye of the engineer at the throttle, and at the same time it is out of the way. The lubricator taking steam for hydrostatic purposes and feeding the lubricant through the single-pipe connection, which is never more than 6 to 10 inches long or high, naturally does away with a long line of piping through the engine room to the boiler or steam gage. The cup is a quick worker and is not affected materially by extreme heat or cold, and will work under high or low temperature. Besides this the cup takes less oil to do the same work than many other lubricators, on account of its compounding oil and water in the feed passage before going directly into the steam. This cup is composed of very few parts, and these have never been better made than by its exclusive manufacturers, The Eastwood Wire Manufacturing Company, Belleville, N. J. Orders can be filled at any supply or ship chandlery store, or from the office of Charles Couse and Company, 39 Cortlandt street, New York city, and also from its makers, the Eastwood Company.

A Valuable Book Free.

The story which recently appeared in Marine Engineering, entitled "The Professor on Shipboard," has been published in book form, making a handsome volume of over one hundred pages.

Every subscriber who will secure a new subscriber for Marine Engineering and remit the price of the year's subscription ($2, domestic; $2.50, foreign) will have sent to him, *free,* a copy of this book. If not a subscriber, it takes two new subscriptions besides your own to win a book.

Nothing has ever been published which contains so much every-day information which every engineer ought to know, as this book. Therefore, no working engineer or man connected with marine work can read any book which will be of such value to him. In addition to the practical information it contains, it is a most readable story of life at sea.

Briefly told, the story is of a college professor of engineering, who has many excellent ideas, some of which are rather *theoretical,* who makes the trip to Brazil and back with his brother, who is Chief Engineer of a steamship, and who has had much *practical* experience. The discussions bring out some strong points which will deeply interest every man who has anything to do with a steam plant.

The table of contents is as follows:

Chapter I.
In the Fireroom.
Chapter II.
Hardships of Firemen.
Chapter III.
Night Watch in a Gale.
Chapter IV.
Interview with Barney, the Oiler.
Chapter V.
Some Points on Lubrication.
Chapter VI.
Why Engines are Non-efficient.
Chapter VII.
Salt Water and Boiler Scale.
Chapter VIII.
Cleaning Boilers in a Tropical Port.
Chapter IX.
How to Use Indicators.
Chapter X.
Simple Explanation of the Indicator.
Chapter XI.
Overhauling the Machinery.
Chapter XII.
Painting the Pipe System.

THE BOOK IS SOLD FOR $1.00, INCLUDING POSTAGE.

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" 57, E. B. Meeker, 71 Abeel St., Kingston, N. Y.
" 58, E. Capers Haselden, P. O. Box 31, Georgetown, S. C.
" 59, Daniel L. Kemp, Box 36, East Boston, Mass.
" 62, Nathan S. Lawrence, 30 Connecticut Ave., New London, Conn.
" 65, Wm. McCarrel, 8 Vernon St., Charleston, S. C.
" 67, Wm. S. Bradley, Saugatuck, Mich.
" 70, Chas. T. Smith, 536 1-2 Commercial St., Astoria, Ore.
" 72, Thomas Navagh, 40 Lake St., Oswego, N. Y.
" 73, Louis Garot, Box 1526, Green Bay, Wis.
" 75, Arthur J. Thompson, Alexandria Bay, N. Y.
" 76, Orson Vanderhoef, Grand Haven, Mich.
" 77, Jos. P. Brewer, 206 N. Ninth St., Manitowoc, Wis.
" 78, F. A. Rehder, 29 W. Superior St., Duluth, Minn.
" 80, R. P. Cook, 46 Elm St., Albany, N. Y.
" 81, Jas. L. Sweeney, 204 E. Saragossa St., Pensacola, Fla.
" 82, Fred H. Gowell, 427 Middle St., Bath, Me.
" 84, Joseph F. Dumas, 403 Dauphin St., Mobile, Ala.
" 85, G. H. Miller, 412 Fifth St., Alpena, Mich.
" 86, Sherman A. Smith, 737 Menckannee Ave., Marinette, Wis.
" 87, Geo. B. Milne, 1003 Trumbull St., Detroit, Mich.
" 88, C. O. Chapman, S. B. Canal, Sturgeon Bay, Wis.
" 89, Robert Vallance, 69 Morris St., Ogdensburg, N. Y.
" 91, Robert Davidson, 17 Fairfield Ave., Harbor Sta., Ashtabula, O.
" 92, H. E. McArthur, Courier-Herald Bldg., 3d floor, Saginaw, W. S., Mich.
" 93, M. E. Davis, M. T. & S. Co., 929 D St., N. W., Washington, D. C.
" 94, George R. Jones, Box 222, Washington, D. C.
" 95, A. P. Jerguson, Box 198, Key West, Fla.
" 100, Thos. Sullivan, Honolulu, H. I.
" 101, Thos. J. Hanlon, Box 765, Norfolk, Va.
" 102, Fred W. Linsemeyer, 210 Clinton St., So. Haven, Mich.
" 103, Herbert Parkins, New Berne, N. C.

TRADE PUBLICATIONS.

The Mianus Motor Works, Mianus, Conn., have issued a leaflet addressed to owners of gasoline engines or to those who are about to purchase one. Therein are described specialties made by this company, including sparking magnetos, water-cooled mufflers, spark points, generators or vaporizers, throttle valves, cylinder oil and grease, etc.

The Judkins Company, East Providence Center, R. I., announces in its handsomely-illustrated catalogue that it is prepared to turn out speed launches, pleasure boats, and, in fact, small boats of any type. The company makes a gas engine of its own, and has the agency for the Motor De Luxe, the Buffalo, the Toquet, Lozier, and Stiles motors, and will furnish customers speed boats equipped with any of these motors.

The Durable Wire Rope Company, 288 Congress street, Boston, Mass., has issued a catalogue describing the process of manufacture and the different styles of Durable cables used for elevators, hoisting, stevedoring, drilling, haulage, dredging, ship rigging, towing-hawsers, etc. The requirements for each of these services are such that a special form of cable is made for each. Prices and dimensions of these various kinds are included in this little booklet, copies of which may be had upon application.

An "at home" booklet is being distributed by the American Blower Company, Detroit, Mich. The purpose of this booklet, as is stated on the first page, "is to acquaint our friends and patrons with our unequaled manufacturing facilities." The booklet contains pictures showing the vast extent of the shops of this company; also interior views showing where the engines are built, where the blowers are built, the heater and the pipe-connecting departments, the exhaust fan and wheel shops, pattern and blacksmiths' shops, galvanizing shop, storage house, power plant, drafting room, etc.

The Metropolitan injectors, manufactured by the Hayden and Derby Manufacturing Company, 85 Liberty street, New York city, will be found fully described and excellently illustrated in a 48-page catalogue which is now being distributed. The five specialties of this company are the Metropolitan automatic injectors, Metropolitan "1898" injectors, Metropolitan double-tube injectors, Hayden-Derby ejectors and jet apparatus. In addition to descriptions of the several specialties, the catalogue contains a great deal of useful information relating to injectors and ejectors. Copies can be had free by referring to MARINE ENGINEERING.

Electrically Operated Valves is the title of special catalogue E, which is now being distributed by the Chapman Valve Manufacturing Company, Indian Orchard, Mass. This catalogue will be particularly interesting to those of our readers interested in steam-power plants and dry-docks, as these are among the special uses for which these valves are recommended. The catalogue is 5 by 8 inches in size and comprises 38 pages. In addition to the text, there are a number of small engravings, giving full detail of the valves and of the members used in connection with them, together with a number of full-page engravings showing very clearly the operation of these valves.

The Lunkenheimer Company, in the revised August edition of its new catalogue, has published a book which will be of much value to steam users and steam fitters. This is the revised edition of the '98 catalogue, and many new specialties will be found described. Space does not permit us to mention the various brass and iron fittings made by this company, but they include valves of every description—angle, globe, pocket, blow-off, gate, radiator, check valves, etc.; whistles, meter cocks, water gages, pressure gages, injectors, lubricators both hand and automatic—in fact, lubricators is one of the most important features of the line of goods carried by this company. Dimensions of valves are given in convenient tables. The book will be found of great use, and copies may be had by interested parties who write to the company at the home office in Cincinnati, or at the branch office, 26 Cortlandt street, New York

When writing to advertisers please refer to MARINE ENGINEERING.

Electric Supplies is the title of a new catalogue issued by the H. W. Johns-Manville Company, 100 William street, New York city. This book contains 108 pages and includes a full line of heaters, rail bonds, overhead line materials, 500-volt fuses, vulcabeston, and special molded insulating pieces, together with many new articles. The value of this catalogue is increased by a comprehensive alphabetical index.

A compact gasoline engine manufactured by August J. Fritz, 185 West Main street, Rochester, N. Y., is described in a leaflet recently issued. The maker builds open and cabin boats, yachts, and launches, besides this marine gasoline engine. A specialty is also made of knockdown construction. Skeleton parts of boats, castings for engines, and fittings, together with drawings to work from, can be supplied.

The Crandall Packing Company has just issued a new edition of its catalogue which is more complete and comprehensive than those previously issued by this company. It measures 6 by 3 1-2 inches, contains 32 pages, and illustrates and describes various kinds of Crandall packing—namely, hydraulic coil, expansion rings, sectional ring, expansion coil, high-pressure ring, etc., etc. The company also manufactures a line of round and flat gaskets, packing, etc. Copies of this catalogue may be had by addressing the home office, Palmyra, N. Y., and the New York office, 136 Liberty street.

The August bulletin No. 1 of the De Laval Steam Turbine Company, 74 Cortlandt street, New York city, describes the test of a 300-horse-power turbine dynamo. The turbine tested was used for driving two direct-current electric generators. The bulletin states that the tests were conducted with both saturated and superheated steam. The latter at full load required but 13.94 pounds of water per break horse power per hour, and at 56 per cent. of the load 15.53 pounds. The comparison of the two tests shows that a little over one pound of steam is saved by superheating. This bulletin is a valuable contribution on the general subject of steam turbines. Copies of it can be had by applying to the company.

"Steam Economy with Highest Efficiency" is the title of a folder issued by the Sleeper Engine Company, Ltd., Montreal, Canada. This engine, in external appearance and in principle, is entirely different from other engines on the market. It is a reciprocating engine, differing, however, from the ordinary engine of this type in that the expansion chamber, which takes the place of the cylinder, has a flexible wall, made up of two parts connected by a crank, the whole member being attached to a crank shaft by a connecting rod. Steam is admitted to the chamber by a valve, giving to the flexible wall an outward movement which actuates the crank shaft or, in one design, a crank eccentric. This interesting engine, which is made either simple or compound, is well described and illustrated in this folder. The machine was tested by the McGill University, of Montreal, with satisfactory results.

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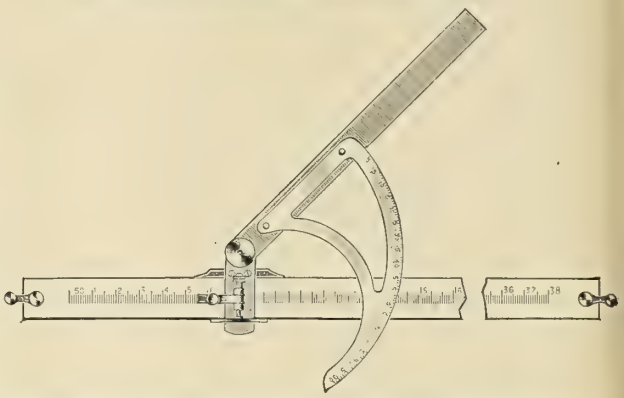

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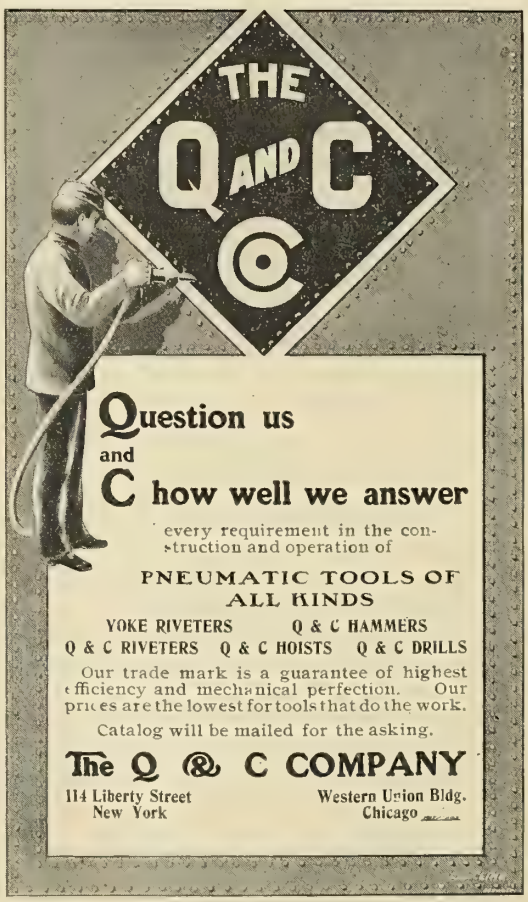
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Direct-Current Factory Motors and Small Generators is the title of a handsomely-illustrated 16-page catalogue issued by the Rochester Electric Motor Company, Rochester, N. Y. The details of these machines are illustrated and described, and the illustrations are given of various types of motors. There is also included a list of sizes for different speeds, horse powers, and voltage.

Catalogue No. 12, entitled, "Duplex Drill Lathes, Hand Lathes, Slide Rests, and Spring Coilers," has recently been issued by the Garvin Machine Company, Spring and Varick streets, New York city. Therein are described and illustrated the above-named machines, which are made by this company. There are also given dimensions, floor space required, shipping weight, etc., of each of these machines.

A new model of profiling machines is being put on the market by the Pratt and Whitney Company, 136 Liberty street, New York city. This machine is handsomely illustrated and fully described in a 10-page booklet, printed in two colors, which is now being distributed. Each special feature of the machine is fully explained, and there are specifications of the one-spindle and also of the two-spindle machine, together with such other information as any purchaser would be liable to want.

A short story of Sir Henry Bessemer is published by Wyman and Gordon, Worcester, Mass. A sketch of this great man's life is called by some a "Romance of Inventions." The name of Bessemer is known the world over, but there are probably few people who know what hardships this man had to contend with. The publishers of this pamphlet make forgings of all kinds, one of their specialties being duplex steel forgings turned out by drop hammer, steam hammer, or hydraulic press.

The Fort Wayne Electric Works, Incorporated, Fort Wayne, Ind., have recently issued bulletin No. 1,030, describing single-phase generators. Each member of the machine—namely, the framing, coils, armature, brush mechanism, commutator, etc.—is taken up in turn and illustrated and described. The machines are made on the Wood system, and many of them have been installed, as can be seen by referring to the list published. A table of the general dimensions of the alternators is given.

The Perfected Ship Log is the title of a handsome catalogue issued by the Nicholson Ship Log Company, Cleveland, O. This machine is operated hydraulically or by the varying level of water in a vertical pipe which has two sea connections, the level of the water changing with the speed of the ship. The recording mechanism is operated by a clock which consists of a revolving drum over which travels a pencil point, recording the speed at each hour. There is also a counter which adds up the total number of miles traveled, and an indicator showing at what speed the ship is traveling. The catalogue will prove of much interest to the maritime world generally.

WATCH THIS SPACE FOR OUR NUMEROUS SPECIALTIES.

WALWORTH MFG. CO. TOOLS and SUPPLIES for STEAM WATER and GAS USERS BOSTON MASS.

THE BOILER BLOW OFF VALVE "NEVER STICK"

Opens or closes easily under pressure.
Large ports. Discharges through plug.
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Made very heavy and strong.
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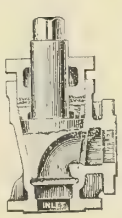

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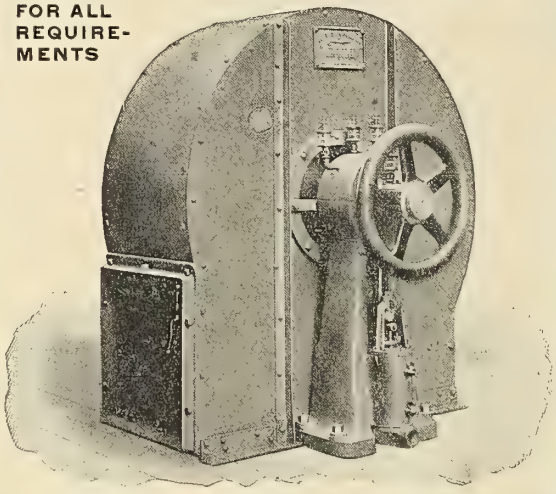

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"The Paint Question," "Paints in Architecture,"
"House Paints: A Common Sense Talk About Them,"
"French Government Decrees."

The Manville Fire Extinguisher is the name of a new article now being put on the market by the H. W. Johns-Manville Company, 100 William street, New York city. The extinguisher, which is in the form of a powder, is described in a booklet issued by the company. This powder, it is stated, is non-poisonous, will not freeze nor cake in the tubes, is not affected by dampness, and will not deteriorate with age.

In the department of Science and Technology, Pratt Institute, Brooklyn, N. Y., there is conducted a two-year technical course in steam and machine design and applied electricity. These courses are intended for those to whom a four-year college course in engineering would be impossible on account of lack of time or money, and who need some technical training before entering mechanical or electrical work. Starting with low requirements for admission, there is given thorough training, theoretical and practical, in mechanical drawing, machine design, shop practice, machine construction, steam engineering, and electricity. Evening technical courses are conducted. Further particulars and circular of information may be had by addressing Arthur L. Willister, director of the department.

The Mason hand lathe is illustrated and described in a handsome 16-page catalogue recently issued by the Kemp Machine Works, 246 Plymouth street, Brooklyn, N. Y. This little machine is capable of doing much work which has heretofore been assigned to expensive power tools, is light and durable, weighs but little over 100 pounds, and is sold for a very low figure. With one man's power it is claimed to cut a thread from 1 to 2 inches and from 2 1-2 to 6 inches, inclusive, at the standard taper. It can be used for cutting pipes and threads, and does work accurately. Many of these little machines are used on board the American, Russian, German, and British warships, and Admiral Melville and other members of the Navy are quoted as highly recommending it. Copies of the catalogue may be had by addressing the manufacturers and mentioning Marine Engineering.

Yacht Design is the title of an attractive leaflet issued by George Crouse Cook, naval architect, 15 Whitehall street, New York city. It contains a few well-selected remarks on the principles of yacht design, takes up the general features of steam and sail yacht design, the methods of construction, cost, etc.

The Universal double-tube injectors, manufactured by L. Schutte and Company, Philadelphia, Pa., will be found fully described in a catalogue which this company is now distributing. The injector is described in much detail, and a number of illustrations are given, and sectional views of all injectors with pipe connections.

The Standard improved drill chuck is described in a leaflet issued by the Standard Tool Company, Cleveland, Ohio. The features claimed for this chuck are that it has no projecting jaws, the working parts are of generous dimensions, the jaws and screws are of cast steel, carefully tempered and of uniform quality, and that the jaws are guided by three large gibs. These drill chucks are made in five sizes ranging in size for holding tools of from 1-4 to 1 inch in diameter.

Direct-current belted generators and motors of the Wood systems are described in bulletins Nos. 1,025 and 1,032 issued by the manufacturers, the Fort Wayne Electric Works, Incorporated, Fort Wayne, Ind. Details of the armature core and coils, brush holders, commutator, frames, etc., are given, and each member is described. Tables of dimensions and capacities of machines are also included. We presume copies of the bulletins may be secured by writing to the company and mentioning Marine Engineering.

The Industrial Press, 9-15 Murray street, New York city, has now ready for distribution section A of the Mechanical Index, comprising machine tools, metal-working machinery and accessories, including machinists' small tools, etc. The complete work is intended as an encyclopedia and list of manufacturers in the United States of mechanical appliances and tools operated by steam, electricity, water, air, hand or foot power, carefully arranged in sub-headings for quick reference. The price of the book is given as $1.

Catalogue No. 29, describing the Hunt cable railways, has recently been issued by the C. W. Hunt Company, West New Brighton, New York. This system of railways has been installed by large consumers and handlers of coal, ore, and other bulk matter. Some interesting and large systems are described in the catalogue, copies of which may be had upon writing to the manufacturer.

Transportation of material through manufacturing establishments is an important problem for the general manager. The C. W. Hunt Company, whose New York address is 45 Broadway, has devoted much attention to this problem, and has developed a system of industrial railways and car equipment to meet the demands of the various kinds of factories. Bulletin No. 0216 describes and illustrates the system of shop transportation.

In St. Louis much attention is being paid to the system of oil burning, and the National Oil Burner and Equipment Company, with offices in the Carleton Building of that city, is attacking several sides of the problem. The company has placed on the market oil burners for domestic uses, for welding furnaces, and for boilers. The piping arrangement in one of these systems is illustrated in a circular recently published by the company.

A striking illuminated sheet is being distributed by the Peerless Rubber Manufacturing Company, 16 Warren street, New York city. It is a view of the lower part of New York, taken from the river, showing the numerous skyscrapers in the background, and the steam craft of various types in the foreground. It is stated that the steam plants in both buildings and ships which are shown are packed with this company's Rainbow Packing.

BUSINESS NOTES.

TO BUYERS OF ENGINEERING BOOKS.—The Derry-Collard Company, 256 Broadway, New York city, has opened extensive offices to make a specialty of supplying engineering books for any line of work. In a neat circular the company states that it does not propose to take the book buyer's money whether or not he is satisfied with the books. All the company asks is that those who wish to buy books or to examine books referring to any subject notify this company. The prospective buyer can examine the books, and, if he wants them, pay for them. If not, he can send them back. The circular states: "You can have any technical book, published by any one anywhere, costing a dollar or more, on approval for two or three days, so that you may examine it thoroughly, on these terms. There are no strings to this proposition; the things are placed in your hands on honor; there's no game of references from your pastor, no hesitation whatever in placing these things in your hands on trust."

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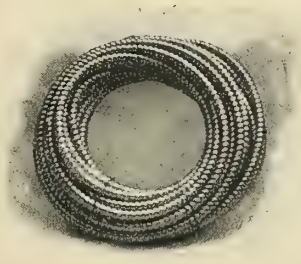
A LAUNCH FOR BOMBAY.—Last month the International Power Vehicle Company, Stamford, Conn., shipped to Bombay, India, a 21-foot launch equipped with one of its kerosene-oil engines. The launch has been purchased for an English official, and will be the only boat of its kind in the vicinity of Bombay. It will be forwarded by way of Genoa and the Suez Canal. When the company began operations, a year or so ago, a force of eight or ten men was employed. To-day the working force numbers about 60 men, and the prospects are that this number will be added to continually. Engines are now being made ready for shipment to Bombay, Calcutta, Singapore, Rangoon, Penang, Manila, Hong Kong, Shanghai, Tien-Tsin, and other places near the equator.

A FINE CATALOGUE FREE.—The Waterbury Brass Company, 122-130 Center street, New York city, has now ready for mailing a new stock catalogue, and any of our readers wishing a copy can have one free by mentioning MARINE ENGINEERING. This catalogue covers very fully the subjects of brass, copper, bronze, and German silver in sheets, rods, and wire; also brass and copper seamless drawn tubing. All these goods are carried in stock in large quantities in this company's warehouse. The catalogue also has much to say regarding stair treads, moldings, brass ferrules, and checks. One important feature of the catalogue are the complete tables of weights and measures bearing on brass and copper sheets, rods, wire, and tubing.

FLEXIBLE METALLIC CONDUIT

For Modern Electric Wiring



Our Flexible Metallic Conduit, Flexible Steel Armored Conductors, and Steel Armored Flexible Cord are particularly well adapted to all classes of Marine work. They afford thorough protection to the wires and insulation from rodents, mechanical and other injuries, are water-proof and simple to install.

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SPRAGUE ELECTRIC COMPANY

General Offices: 527-531 West 34th Street, New York

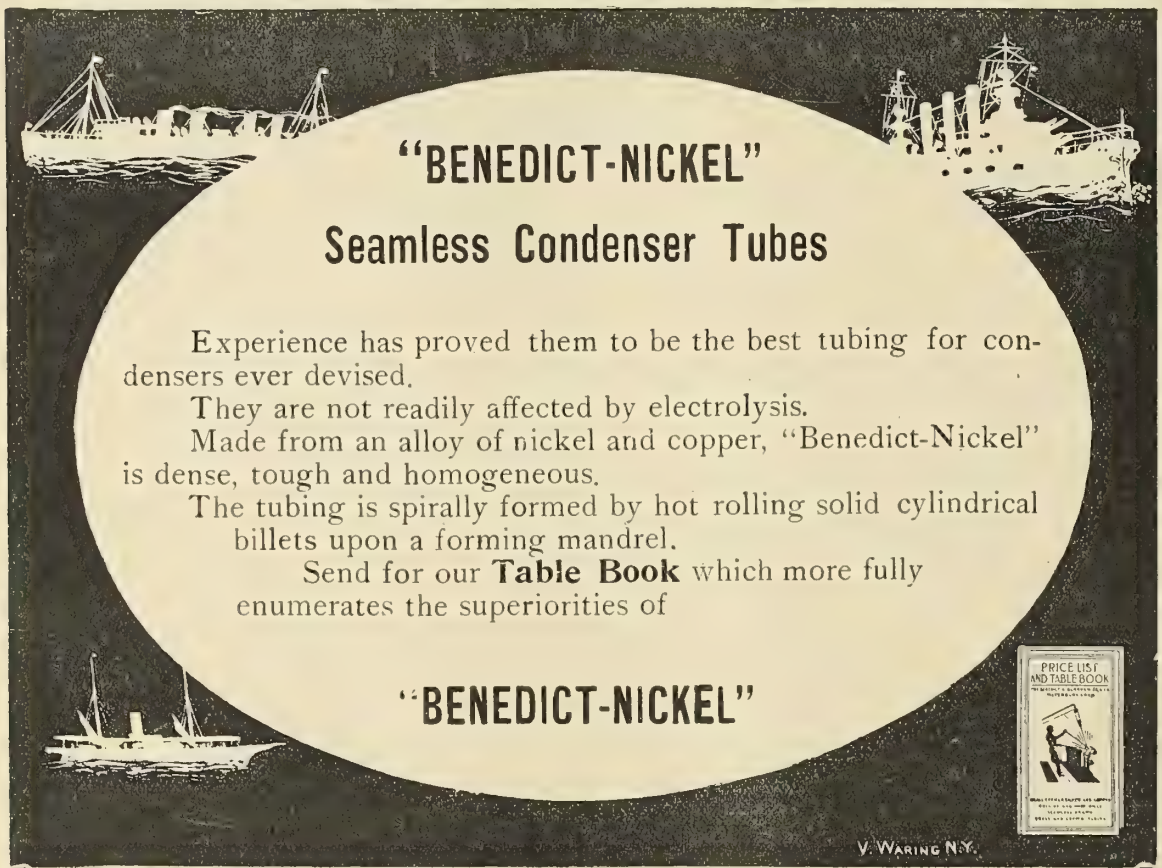
Chicago: Fisher Bldg. Boston: Weld Bldg. St. Louis: Security Bldg. Baltimore: Maryland Trust Bldg.

Marine Refrigerating Machines.—Owing to the increased demand for refrigerating and ice-making machines, the Brunswick Refrigerating Company, New Brunswick, N. J., has built and equipped a new factory. The company has just moved into the new plant, and, with the increased facilities, is now prepared to do all kinds of refrigerating work, both land and marine.

Staybolt Iron.—We are informed by the Falls Hollow Staybolt Company, Cuyahoga Falls, O., that its customers are reporting the best of satisfaction with this company's staybolt iron, both hollow and solid. The company has customers among marine and other boiler manufacturers throughout all parts of the United States, and is shipping large orders to Mexico, Canada, Japan, and nearly all the countries of different corners of the world. The company has just employed Mr. T. F. De Garmo, 3116 Clifford street, Philadelphia, Pa., as its Eastern representative. Mr. De Garmo has had many years' experience in the supply business.

Pneumatic Tools.—The pneumatic tools used in riveting the hulls of the *Kroonland* and *Friesland*, the two new steamships built at the yard of Wm. Cramp and Sons' Ship and Engine Building Company, Philadelphia, Pa., for the International Navigation Company, were supplied by the Chicago Pneumatic Tool Company, Chicago, Ill. The requirements in the way of riveting were very severe, as the plates used in the hulls of these ships are the heaviest yet made use of in the shipyards of this country.

Submarine Paint for Battleship Maine.—Just before her trial trip, last month, the battleship *Maine* was placed in dry-dock in the Brooklyn Navy Yard, to be painted and cleaned. The builders, naturally, desired to make as high a speed record with this ship as possible, and we are informed that she was carefully coated with American-McInnes composition, furnished by George N. Gardiner and Son, 53 South street, New York city; these compositions being used as they make a very smooth sailing surface, and, consequently, give opportunity to make high speed.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They are not readily affected by electrolysis.
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We are also among the largest manufacturers of Seamless Brass and Copper Tubing (made by the same process as "Benedict-Nickel"), and of brass and copper sheets, wire, etc.

TOBIN BRONZE.—We sell it at manufacturer's prices.

BENEDICT & BURNHAM MFG. CO.,

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New York, 253 Broadway. **Boston, 172 High Street.**

Peerless Packing.—In a recent letter to the Peerless Rubber Manufacturing Company, 16 Warren street, New York city, Asa P. Hyde, Binghamton, N. Y., wrote as follows: "By to-day's U. S. Express I send you three of the four rings of 'Peerless Packing' taken out of Corliss engine piston gland (one I wish to keep to show to packing men and engineers). The same was applied January 28 last, and has run continuously for 10 1-2 hours each day since, giving not the slightest trouble, packing perfectly, running the lightest of all. Of all others tried before, and I have tested many, they would not run to exceed ten to twenty days. Yours went on where the others had left off, with no changes, and made the record. Was good for much more, but other repairs caused the change now. Piston speed, 560 feet per minute; steam pressure, 80 pounds; piston travel one day, 352,800 feet; piston travel 133 days' run, 46,922,400 feet, and good yet."

A Word to the Wise

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The long-wear kind. Made of packing encased in soft annealed copper.
Can be reapplied indefinitely.
Big and little—for manhole, handhole and pipe fittings.
One grade—the best we can make.
Prices and catalog on request.

McCord & Co.

104 Broadway, New York
1471 Old Colony Bldg., Chicago

Large Valves.—In a recent issue, one of the Springfield (Mass.) papers stated that the Chapman Valve Manufacturing Company, Indian Orchard, Mass., has received from the Newport News Shipbuilding and Dry-dock Company an order for the largest brass valves the company has ever made. These valves are eight in number and are to be used on pipe of 20 inches and 21 inches inside diameter. They are made entirely of Government bronze, and when completed will weigh 1,800 pounds each. These valves are to be used on vessels being built at the Newport News yard as follows: *West Virginia, Maryland, Virginia,* and *Charleston.*

Foster Steam Specialties.—We are informed by the Foster Engineering Company, Newark, N. J., that the annual report of Rear Admiral Melville, of the United States Navy, shows that during the year 1901 the Foster Company furnished to the Engineering Department of the Navy automatic valves and reducing and regulating valves to the aggregate weight of 17,683 pounds. In addition to these orders, the Foster Company has recently filled many other large orders, the Lamson Consolidated Store Service Company taking 186 valves; the Consolidated Heating Company, 45; and many other concerns well known in the industrial world, other large orders.

Ship Fittings.—The increasing demand in the United States for first-class fittings for ships of all types and descriptions has led to the recent organization of The Delaware Marine Supply Manufacturing Company, Wilmington, Del. The authorized capital stock of the company is $100,000. The officers are: C. F. Petersen, president; Louis Werliin, treasurer; C. L. Bonham, secretary; and A. C. Layman, manager, men of experience in marine work, who have equipped the plant, consisting of a brass foundry, brass finishing department, machine shop, forge shop, and pattern shop, with modern tools especially adapted for economical manufacturing. The factory buildings are completed, the machinery installed, and the company has begun to fill orders.

To Build Lighthouse Steamer Crocus.—The Lighthouse Board has awarded the contract for the construction of the twin-screw steel steam lighthouse tender *Crocus* to the Townsend-Downey Shipbuilding Company, New York, builders of the German Emperor's schooner yacht *Meteor.* This vessel will be constructed throughout of steel, with five water-tight bulkheads. The deck house on the spar deck will be built of wood in the most substantial manner. The vessel will have two masts with gaffs and necessary booms. The propelling power will be furnished by two boilers of the gunboat type, 9 feet 7 inches in diameter, 16 feet long, furnishing steam for two vertical inverted direct-acting fore-and-aft compound engines with cylinders 18 inches and 34 inches in diameter, and a common stroke of 26 inches, driving left and right-hand propeller 7 to 8 feet in diameter. The *Crocus* will be finished in detail in the best possible manner, and when completed will be one of the finest steamers in the lighthouse service.

WESTON STANDARD PORTABLE DIRECT-READING

Voltmeters, Ammeters, Millivoltmeters, Voltammeters, Milliammeters, Ohmmeters, Portable Galvanometers, Ground Detectors and Circuit Testers.

Our Portable Instruments are recognized as **the standard** the world over. Our **Voltmeters** and **Ammeters** are unsurpassed in point of extreme accuracy and lowest consumption of energy.

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Waverly Park, Newark, N. J., U. S. A.

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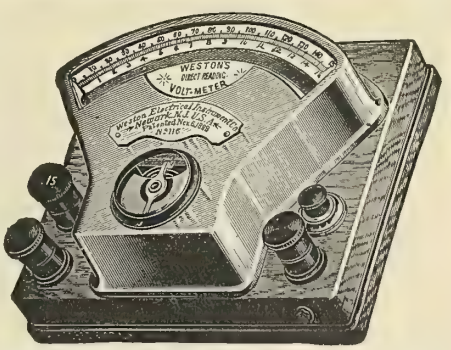

WESTON Standard Portable Direct Reading Voltmeter.

Oil Fuel Under Marine Boilers.—In a recent letter to Tate, Jones, and Company, Incorporated, Empire Building, Pittsburg, Pa., Charles G. Coyle, the president of the Louisiana Petroleum Company, New Orleans, La., stated: "In reply to your inquiry concerning the *Tempest*, we beg to advise that the fuel oil installation erected on this tug by you has proven entirely satisfactory. The boat makes more steam, at a material reduction in the cost of the fuel. The pumping appliance has worked perfectly from the very start, and we have not had a moment's delay, although we have been driving the boat day and night for over two months."

Iron and Steel Sheets.—The Empire Iron and Steel Company, Niles, O., has just built and equipped a large plant. The product will be sheet iron and sheet steel, and angles for light structural work. The company has six hot mills, two cold mills, and a 3-high, 24-inch bar mill. It will manufacture iron and steel sheets up to 60 inches wide and from No. 16 to No. 30 gage. It will make a specialty of "guaranteed" double-refined iron sheet, also Range steel and Bowsocket polished sheet. The galvanizing plant is now in operation. The output of iron and steel angles will be about 100 tons per day. For the present, the heaviest angles will be 4x4.

The Falkenau-Sinclair Machine Company.—The two well-known Philadelphia concerns, A. Falkenau and the Philadelphia Machine Tool Company, have combined their interests and businesses under the name of the Falkenau-Sinclair Machine Company. The company has a large plant at 109-115 North Twenty-second street, and has largely-increased facilities in addition to those secured by combining the two interests. The specialty of the new company will be the designing and building of high-grade machine tools and special machines. At the same time, the company will have a full line of presses and machines for working sheet metals, etc.

The Ideal Pigment

TRADEMARK FEROX REGISTERED JULY 8, 1902.

The only adequate protection for Ships, Bridges, Structural Iron and Steel Work

Mohawk Paint & Chemical Co.

SOLE MANUFACTURERS OF

Patent Iron Oxide Paints

98% Pure

19 Liberty Street, New York

The only **Pure** Iron Oxide Paint.

The only Non-Crystalline Oxide of Iron

Being porous and spongy it absorbs and retains the oil and makes a permanent, durable, unchanging, protective coating for wood and metals.

It is rust-proof and not subject to chemical action.

Unequalled for submarine use.

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A Great Name
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A Great Motor

2 Cylinder · 4 Cycle · Slow Speed

Write for prices now while we can fill your orders.

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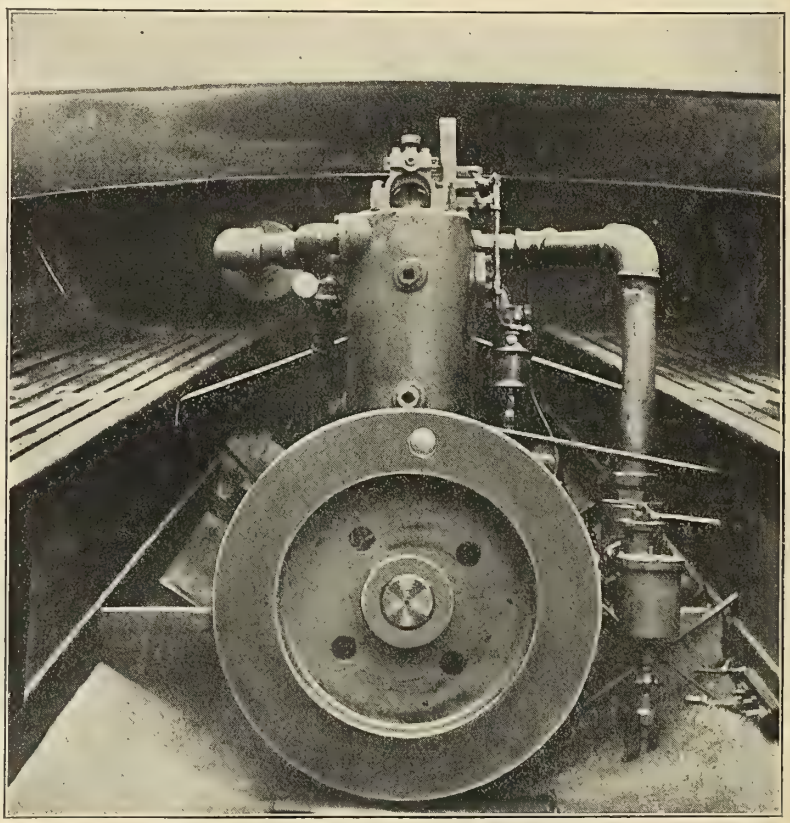

SPECIAL NOTICES.

Announcements under this heading will be inserted at the uniform rate of thirty-three-and-a-third cents a line. Lines average ten words each.

EXPERIENCED MAN SEEKS POSITION.

A foreigner experienced as engine designer and draftsman, and accustomed to the metric system, seeks position; has governmental certificate. Address DESIGNER care Marine Engineering.

FOREMAN BOILER MAKER WANTED.

First-class man wanted for a modern shop building marine and stationary boilers, and doing boiler and iron ship repairs. Applicants will please state age, experience, nationality, and give names of previous employers. This is a good position for a good man. Address P. O Box 2685, Boston.

EDUCATED AND EXPERIENCED MAN SEEKS POSITION.

AN ENERGETIC YOUNG MAN, College technical education; machinist; three years operating dredging machinery; chief-engineer's license for Great Lakes; experienced in indicator work and computation and competent draftsman on detail work; would like a position with some firm manufacturing marine engines or dredging machinery, with chance for advancement. Address J. M A., care Marine Engineering.

FERROFIX FOR BRAZING.—The brazing of iron has long been the dream of inventors, and the recent discovery of the secret was hardly perfected before companies were organized for the purpose of selling the secret throughout the world. The original purpose was to manufacture the compound which makes the brazing possible and dispose of it to the users, but, because of the result of experience in this direction in Germany, the whole method had to be changed, for the reason that it was found that, by actually doing the brazing work, a great deal more money could be made with very little more trouble. Acting upon this idea and improving upon it, the American Brazing Company determined to buy out the American Ferrofix Company, together with all other right, title, and interest, so that it might organize and perfect a large and effective working force throughout the whole United States, in order to control the mending business of the country. The purpose is to have joined with it every responsible blacksmith in the country, so that, instead of one or two agencies in the towns and cities, as is being done in Europe, it will have an agency in every village almost throughout the United States. Statisticians assert that the broken castings in the United States every year amount in value to from ten to twelve million dollars, and the American Brazing Company anticipates being able to divide a large proportion of this among its agencies. A recent writer describes the process of brazing as carried out by the American Ferrofix Company as simple in the extreme. For experimental purposes a bar of iron was taken, of about 1 1-2 inches cross-section; at one point this bar was reduced in cross-section to 1 1-4 inches by filing on all four sides, so as to make a weak point at which the iron would readily break; it was thus broken with several blows of a hammer; and inside of fifteen minutes the two parts were brazed together; and the bar was then clamped in a vise, so that the brazed part would project about an inch from the jaws of the vise; it was then struck repeatedly with a hammer at this point until it broke again; but, instead of breaking at the brazed joint, as would have been expected, it broke a little higher up, and not exactly at the point where the cross-section was least, for this point was already occupied by the brazed joint. A second time the piece was brazed, and a third time it was broken. The third break was on the other side of the original braze, and so close to it that the thickness of metal was probably less than a fiftieth of an inch from the old braze. That is, the bar had been broken three times and brazed twice, but had not broken on the braze either time. The field for this new industry would seem to be almost endless. Broken machines that formerly reached the scrap pile can be carefully cleaned up and repaired. The buyers of broken down machines can reap a harvest if they reach a field where the use of Ferrofix is unknown. Among the prime movers in this company are the William S. Haines Company, 136 South Fourth street, Philadelphia, Pa.

SHIP AND PILE COPPERING.—A circular is being distributed by the Coleman Ship and Pile Coppering Company, State and Washington streets, Boston, Mass., which states: "The practical value of the inventions of George D. Coleman for coppering the bottoms of vessels has been very fully and satisfactorily demonstrated by actual work done during the past two years. The process consists in applying pure granulated copper to the hulls of ships, whether of wood, iron, or steel, and the surface, when finished, presents a coating of polished copper without break or seam. The method is less expensive and far more desirable in every way than using ordinary copper sheets, and requires but little more time than to apply a coat of paint. In adapting the Coleman process to vessels with iron or steel hulls, an intermediate coat of insulating material is introduced, which prevents all possibility of galvanic current being set up to the injury of the structure. When treating wooden piles by the Coleman process, the pile is first thickly studded with copper or yellow metal studs. These studs are driven by a rapidly-operating machine, designed and built by the company, leaving them slightly projecting from the surface of the pile. This surface is then treated in a manner similar to that of a vessel's bottom. The inventions are fully protected by various letters patent of the United States. All work done by the company will be fully guaranteed, both as regards its durability and excellence of workmanship. The company has a fully-equipped plant at Murray and Tregurtha's Wharf, West First street, South Boston, Mass. A similar plant is to be located at once at some convenient point in New York city. Estimates of cost and further details regarding the process may be had upon application at 96 Devonshire Building, 16 State street, Boston, Mass."

Cabins and Staterooms

of modern vessels especially those in the passenger service should demonstrate the supreme possibilities of the wood finisher's art.

This demands a special varnish, however, as atmospheric conditions are more destructive to varnish afloat than ashore and the ordinary article is of but little use.

The varnish best adapted to withstand the deleterious influences of wind, wave and weather is

Berry Brothers' Spar Varnish.

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Rainbow Packing

Makes Steam, Flange and Hot Water Joints Instantly

Thousands of Imitators.

No Equal.

Will Hold Highest Pressure.

Don't have to Use Wire and Cloth to Hold

RAINBOW

Can't Blow it Out.

THE COLOR OF RAINBOW PACKING IS RED

See that the Trade Mark (three rows of diamonds in black, connected) extends throughout the entire length of each yard or roll

WILL CARRY IN STOCK

It is an undisputed fact that Rainbow Packing is the only Sheet or Flange Packing in the world that will carry in stock for months and years without hardening or cracking

The Eclipse Sectional Rainbow Gasket

3/8 in.
1/2 in.
5/8 in.
} For Hand Holes.

3/4 in.
7/8 in.
1 in.
} For Extra Large Joints.

Fac-simile of a 6-inch Section of Eclipse Gasket showing Name and Trade Mark imbedded.

The Eclipse Gasket is red in color, and composed of the celebrated Rainbow Packing Compound. It will not harden under any degree of heat, or blow out under the highest pressure, and can be taken out and repeatedly replaced. Joints can be made in from three to five minutes.

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TRADE PUBLICATIONS.

"The Union Steam Specialties" is the title of a catalogue now being distributed by the Union Steam Specialty Company, Scranton, Pa. These specialties include indicators, separators, oil filters, shaking grates, furnace blowers, steam pumps, and a general line of engineers' supplies.

Draftsmen and others who have to do with drafting-room work will be much interested in a catalogue entitled "Printing on Tracing Cloth," issued by Golding and Company, 183 Fort Hill Square, Boston, Mass. This catalogue describes a compact printing press, designed especially for use in drafting rooms. Copies of the catalogue can be had free by mentioning MARINE ENGINEERING.

Users of paint will want to send for a copy of a booklet entitled "A Great Discovery—the Mohawk Paints," issued by the Mohawk Paint and Chemical Company, 19 Liberty street, New York city. There are many features about the Mohawk paints which will appeal to those who have made a study of the subject of iron paints. These features are brought out in a strong way in this catalogue.

The air tools manufactured by the Port Huron Air Tool Company, Port Huron, Mich., have a very complete and comprehensive catalogue devoted to them. A number of illustrations are given showing the men using the tools in connection with furnace and boiler work, and in addition to several illustrations of this kind, there are pictures of cranes, hoists, and other specialties which this company manufactures.

The dynamos and motors for all purposes manufactured by the Jantz and Leist Electric Company, 808 Elm street, Cincinnati, O., are illustrated in a series of sheets which the company is now distributing. These include generators, especially of small sizes, such as would be used in marine electric plants. This company also furnishes, when desired, complete plants for marine purposes, direct connected to steam engines.

Many publications have been issued by the passenger department of the New York Central and Hudson River Railroad Company, and now an illustrated catalogue of these publications, especially of books of travel and education, has been issued. Copies of this catalogue can be had free by addressing George H. Daniels, General Passenger Agent, New York Central and Hudson River Railroad Company, Grand Central Station, New York.

The Vulcabeston Packing, manufactured by the H. W. Johns-Manville Company, 100 William street, New York, is described in Catalogue V, which has just been published. The increased pressure used in marine steam plants is the main reason why this packing is offered to the public. The text gives full information regarding the composition and construction of the packing, and there is a great deal of information regarding its various uses, sizes, etc.

A very compact, neatly-printed catalogue is now being distributed by the Buffalo Forge Company, Buffalo, N. Y., regarding the Buffalo down-draft heating forges for industrial works. The catalogue is about 4 inches by 7 inches in size and comprises 52 pages. There is an average of more than one illustration to a page, so that it can readily be seen that the catalogue is very complete, and that the various types and styles of forges are thoroughly illustrated. Any one at all interested in the subject of forges should send for a copy of this catalogue.

The marine gasoline engines and launches manufactured by the Frank M. Watkins Manufacturing Company, Baymiller and Sixth streets, Cincinnati, O., will be found described in the catalogue which this company issues. The catalogue is 6 by 9 inches in size and contains full-page engravings of the single-cylinder, also of the two-cylinder engine, affording opportunity to understand fully the design and arrangement of the engine. The text describes concisely the special features of the engine, and drawings in the back part of the catalogue illustrate some of the hulls which this company manufactures.

"A Practical Method of Dealing with the Expense Due to the Neglect of Boilers" is the title of a pamphlet which has been issued by the Blackburn Smith Company, 29 Broadway, New York city. The title is one that will appeal to every one of our readers who has to do with steam plants. A copy can be had by applying to the company for one and mentioning MARINE ENGINEERING.

"An Industrial Problem" is the title of a booklet published by W. S. Rogers, Keene, N. H. The booklet is devoted to a system of keeping costs in factories, and is the result of Mr. Rogers' own experience in shop management. The book is not sent free, but a charge of ten cents is made. Any manufacturer or superintendent who has the handling of shop work will find it a good investment.

The Universal Drafting Machine, manufactured by the Universal Drafting Machine Company, Cleveland, O., is fully described in a catalogue which is now being distributed. The catalogue is 6 by 9 inches in size, and on each left-hand page is a large illustration showing the machine in use, so as to illustrate as graphically as possible the manner in which it is made use of. Any one who has to do with drafting work will appreciate one of these catalogues.

The Fort Wayne Electric Works, Fort Wayne, Ind., issues frequent bulletins describing the several specialties of this company, each bulletin being complete in itself. Among the bulletins just received is No. 1029, devoted to enclosed, direct-current, 110-volt arc lamps; 1034, devoted to standard small motor panels; 1028, devoted to enclosed, direct-current, power-circuit arc lamps, multiple-series type. Copies of any or of all these bulletins can be had upon application.

"Davidson Propeller Fans" is the title of a handsomely-published catalogue now being distributed by the Massachusetts Fan Company, Waltham, Mass. The catalogue comprises 32 pages, handsomely printed on heavy coated paper, and it is bound in heavy paper cover, which is neatly printed in two colors. These fans are made for heating, ventilating, drying, and other purposes. Large illustrations are given to show the styles of the fans, and each type is concisely described. The fans are made to be driven either by electricity or steam engines.

The air compressors manufactured by the Chicago Pneumatic Tool Company in its works at Franklin, Pa., will be found splendidly described in a 72-page catalogue which is now being distributed. The catalogue is very handsomely printed and equally well illustrated. These compressors are designed primarily for use in connection with pneumatic tools of all kinds, but, of course, can be used for any purpose where compressed air is desired. The illustrations in the catalogue were all made especially for it, and there is altogether a great deal of very valuable information regarding both air compressors and the many uses of compressed air. The many tables add much to the value of the catalogue. The illustrations show nearly all kinds of pneumatic tools, so that altogether the catalogue is an unusual treatise on the subject.

A Most Useful Book for Engineers and Draughtsmen

Hawkins-Emett Diagramal Formulae

IT CONSISTS OF

25 cards, about 8x10 inches in size, on each of which is worked out diagrammatically some special part of engines of different powers, such as thickness of cylinder walls, diameter of piston rods, area of port openings, etc.

PRICE, $3.00, POSTPAID

Marine Engineering, 309 Broadway NEW YORK

AMONG THE FINE MECHANICAL TOOLS WHICH WE MANUFACTURE FOR THE USE OF ENGINEERS AND MACHINISTS

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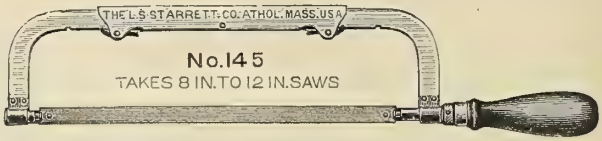
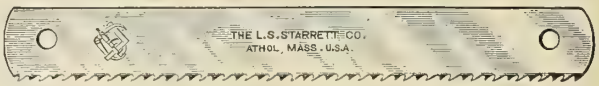


FOR SAWING TUBING, BRASS, COPPER AND SHEET METAL.

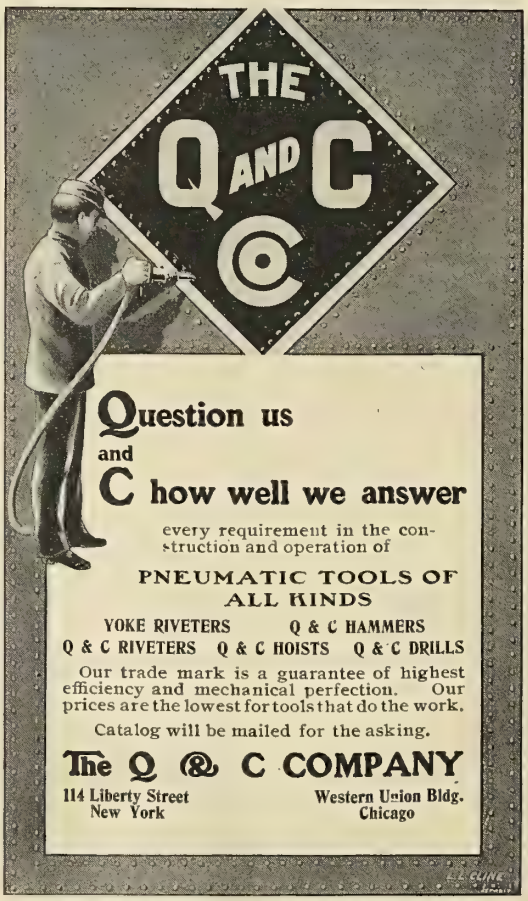


These blades are made of the finest steel; the teeth are sharp and too hard to file.

Every Engineer should have them among his tools.

The L. S. Starrett Co., Athol, Mass.

A copy of our Catalogue No. 16 L can be had for the asking.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Our trade mark is a guarantee of highest efficiency and mechanical perfection. Our prices are the lowest for tools that do the work.
Catalog will be mailed for the asking.
The Q & C COMPANY
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THE smoother the hull of the yacht, launch or other fast boat, the greater the speed. Dixon's Pot Lead offers less resistance to the water than any other treatment of hulls. Circular and samples sent free.

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WE CARRY IN STOCK

TWENTY (20) FT. SEAMLESS DRAWN COPPER TUBES, INSIDE DIAM. ALL B. W. G., IN VARIETY OF THICKNESS OF WALL.

TWELVE (12) FT. SEAMLESS BRASS AND COPPER TUBES, INCLUDING IRON PIPE SIZES.

HOT AND COLD ROLLED COPPER BOLT, BRAZIERS' SHEET COPPER AND COPPERSMITHS' RIVETS, SPELTER SOLDER.

CONDENSER TUBES TINNED, 5-8 AND 3-4 X 18 B. W. G., IN 25 FT. LENGTHS.

CONDENSER TUBES AND HEADS, SPECIAL LENGTHS AND MEASUREMENTS FURNISHED FROM MILL.

Send for our new stock list classifying **A MILLION** pound of Brass and Copper.

WATERBURY BRASS COMPANY
122 TO 130 CENTRE STREET, - NEW YORK

The Bourne-Fuller Company, Cleveland, O., issues each month a stock list of iron, steel, pig iron, and other specialties which this company handles. Any user of angles, channels, plates, rivets, sheets, etc., will find this list of much value for reference.

The Canada Launch Works, foot of Carlaw avenue, Toronto, Canada, recently issued a neat catalogue for distribution at the Toronto Exposition. It is entitled "Boat Talks." Any one who is interested in launches and yachting will find it well worth while to send for a copy of this catalogue.

Users of gas engines will read with much interest a small catalogue issued by the Hendricks Novelty Company, 617 South Illinois street, Indianapolis, Ind., describing the Hendricks gas-engine igniter. This is a form of magneto and is designed especially to use in connection with explosive engines. It is to use in connection with a jump-spark coil. The catalogue contains illustrations of the igniter, showing its construction, and the text fully describes its design and operation.

BUSINESS NOTES.

CONSULTING ENGINEER AND NAVAL ARCHITECT.—R. L. Newman, who has been connected with shipbuilding in this country for many years with the Cramp Company, later as general manager of the Globe Iron Works in Cleveland, and more recently as general superintendent of the New York Shipbuilding Company, has opened an office at 187 Chesebrough Building, Bowling Green, New York city, as consulting engineer and naval architect. The development of designs and superintendence during construction will receive his special attention. Vessels for carrying oil in bulk will be a specialty, also surveys on general repairs.

BRASS AND COPPER MARINE SPECIALTIES.—The Waterbury Brass Company, Waterbury, Conn., is now making its New York office, 122-130 Center street, a very important warehouse for handling all of its specialties. This warehouse has an immense floor area, and there is in stock here at all times everything that could be asked for in the line of regular and special shapes and sizes in brass, copper, bronze, etc. The company issues a very complete catalogue, which should be in the hands of every user of brass and copper specialties, as it not only describes the various manufactures of this company, but gives much valuable information regarding the uses of brass, copper, and bronze in marine work. This company has secured the right to manufacture Pope's Island white metal, which is noncorrosive and which is very desirable for many marine uses. Full information regarding this metal can be had upon application to the company, either at the head office in Waterbury or at the New York branch.

WATCH THIS SPACE FOR OUR NUMEROUS SPECIALTIES.

WALWORTH MFG. CO. TOOLS and SUPPLIES for STEAM WATER and GAS USERS BOSTON MASS.

Always Use the STILLSON Adjustable Pipe and Nut Wrench.

TAKES SIZES 1/8 UP TO 5 INCHES

MADE OF BEST TOOL STEEL THROUGHOUT

The Only WRENCH That Gives Entire Satisfaction.

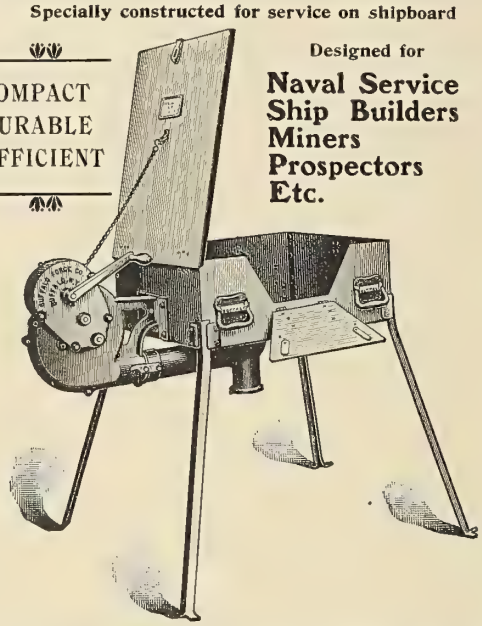
JOBBERS SELL THEM—IF YOURS DON'T, WRITE.
New York, Park Row Building. **WALWORTH MFG. CO.,** Boston, 128 Federal Street.
Write for our BLUE CATALOGUE "D." showing complete line of engineers' pipe fitting tools.

BUFFALO FOLDING FORGES

Specially constructed for service on shipboard

COMPACT
DURABLE
EFFICIENT

Designed for
Naval Service
Ship Builders
Miners
Prospectors
Etc.



Buffalo Forge Company
BUFFALO, N. Y., U. S. A.

Salt Air Searches Paint

If there be any weakness the sea will find it. Common paint may deceive the "land lubber," but the "old sea-dog" demands

ZINC WHITE

FREE: Our Practical Pamphlets
"The Paint Question,"
"Specifications for Architects,"
"Paints in Architecture,"
"French Government Decrees."

THE NEW JERSEY ZINC CO.
11 Broadway
New York

Rivet Cement for Hulls.—The U. S. Gutta Percha Paint Company, Providence, R. I., is sending out a very neat circular regarding Rice's gutta percha rivet cement for hulls and steel vessels. The following distinguishing features of this improved cement are given in this circular for the benefit of yacht owners, shipbuilders, and others. It is easily and quickly applied, either with a trowel or, when thinned with turpentine, with a brush; it dries in an hour or two, so that it can be rubbed; it takes a less quantity to form a smooth surface than other cements; it can easily and quickly be brought to a surface as smooth as glass and very free from ridges or furrows by using sandpaper or pumice stone without rubbing through to the metal; its tenacity and adhesiveness are not excelled; it protects plates from rust and pitting, and stands great heat and hard usage; it is sold by the gallon, not by the pound; and is claimed to be very economical because it covers as much surface as that of any other cement. Any of the readers of Marine Engineering interested in the subject of cement will find it worth while to send for a copy of this circular.

Racing Sails for Italy.—Wilson and Silsby, Rowe's Wharf, Boston, Mass., have recently furnished a suit of sails for an Italian yacht, which is to compete for a well-known French trophy. A yacht owned by King Edward of Great Britain will take part in the same races.

Catalogue Cabinet

Will take care of any and all sizes of Catalogues, Price Lists, etc., and so indexed that you can get any one you want instantly.

Contains five drawers of different heights, and divided into compartments of different widths (each with a follower-block to keep catalogues upright); a cupboard with nine adjustable partitions; and two Card Index drawers for indexing the catalogues under name of firm, as also under name of article for a cross reference. A Sliding Shelf makes the outfit complete. Made of selected quartered oak, and perfect in every appointment.

YAWMAN & ERBE MFG. CO., 360 Broadway, New York
92 Franklin St., Boston; 138 Wabash Ave., Chicago, and Nine other Cities.

TO BURN FUEL OIL.—Steamship *S. V. Lukenbach,* now at Newport News, Va., is to be equipped with the Kirkwood System for burning fuel oil by Tate-Jones and Company, Empire Building, Pittsburg, Pa.

A CARD OF GRAPHITE PAINTS.—An ingenious card, devised for displaying the colors of Dixon's silica graphite paint in such manner as will permit of an exact idea of each color, is issued by the Joseph Dixon Crucible Company, Jersey City, N. J. The color chart carries with it suggestions as to the class of construction that can be protected with this paint, also instruction as to the best methods of applying it. One of these color charts can be secured from the Dixon Company free by referring to MARINE ENGINEERING.

STEAM TOWING MACHINES.—We are informed by the Chase Machine Company, Cleveland, O., that the United States Circuit Court of Appeals has made decision in a suit between the Boston Towboat Company and the Chase Machine Company, which has been in court for six years and has been argued four times. The suit was brought to have the Chase Company enjoined from manufacturing automatic steam towing machines, claiming that the machines which the Chase Company manufactured infringed. This final decision is in favor of the Chase Machine Company, its machine being declared not to infringe.

NICLAUSSE BOILERS.—In the light of the recent test of water-tube and Scotch boilers in the *Minerva-Hyacinth* trials, peculiar interest attaches to the contract just awarded by the British Admiralty for a 16,500-ton battleship of 18,000 horse power, for which Niclausse boilers have been specified. This is the eighth ship of the English navy to be so equipped within the past sixteen months, making the aggregate Niclausse horse power in that navy 114,000, against 105,000 horse power in the United States Navy. These boilers are manufactured in the United States by the Stirling Company, Pullman Building, Chicago, Ill.

MARINE FUEL OIL PLANTS.—Walter Goodenough, marine engineer, with offices in the Battery Park Building, New York city, is handling the Billow System of fuel oil appliances, manufactured by the National Supply Company, of Chicago. This concern has been in the business of designing and installing fuel-oil systems for the past seventeen years, and its apparatus is in use for nearly every purpose that fuel of any sort can be used for. While it makes burners suited to any medium that is convenient to atomization, it has, through its long experience, become convinced that air at about two pounds pressure forms the most economical method of atomizing oil for burning under boilers. All of the apparatus from pumping system to burners is made in the most thorough manner. The fuel-oil plant at the Columbian Exposition was installed by this company, as have been also others, ranging in horse power from 12,000 to 50. Mr. Goodenough is prepared to furnish designs and estimates on the above apparatus to cover any condition required.

For Steam Making Apparatus For Refrigerating

MECHANICAL THERMOMETERS

HOHMANN & MAURER MFG. CO. ROCHESTER, N.Y. TRADE H&M MARK

Write for Illustrated Catalogue M.

NEW YORK 85 Chambers Street
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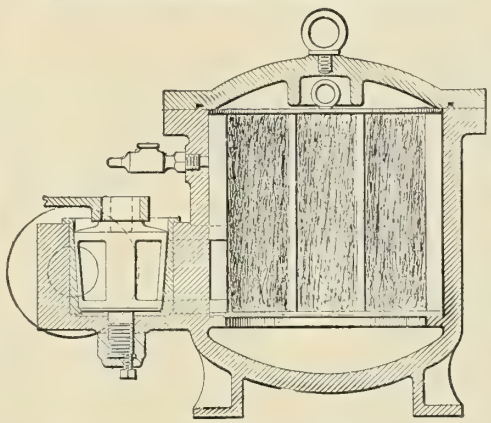
For All Engineering and Manufacturing Purposes

Patent "Reflex" FEED WATER FILTERS

Will pay for themselves in less than a year by protecting your Boilers from Grease, Oil and All Mechanical Impurities.

For Steamships, Yachts, Tugs, Factories



For Electric Power Plants, Hotels, Apartment Houses and Mines

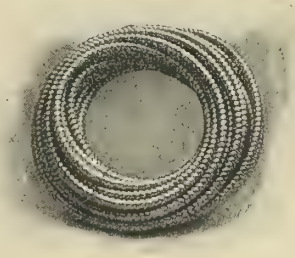
Try them—If you don't like them we'll take them back and refund purchase price.

SEND FOR CATALOGUE AND PRICE LIST.

Blackburn Smith Co., 29 Broadway NEW YORK

FLEXIBLE METALLIC CONDUIT

For Modern Electric Wiring



Our Flexible Metallic Conduit, Flexible Steel Armored Conductors, and Steel Armored Flexible Cord are particularly well adapted to all classes of Marine work. They afford thorough protection to the wires and insulation from rodents, mechanical and other injuries, are water-proof and simple to install.

Write for Catalogue No. 40415

SPRAGUE ELECTRIC COMPANY

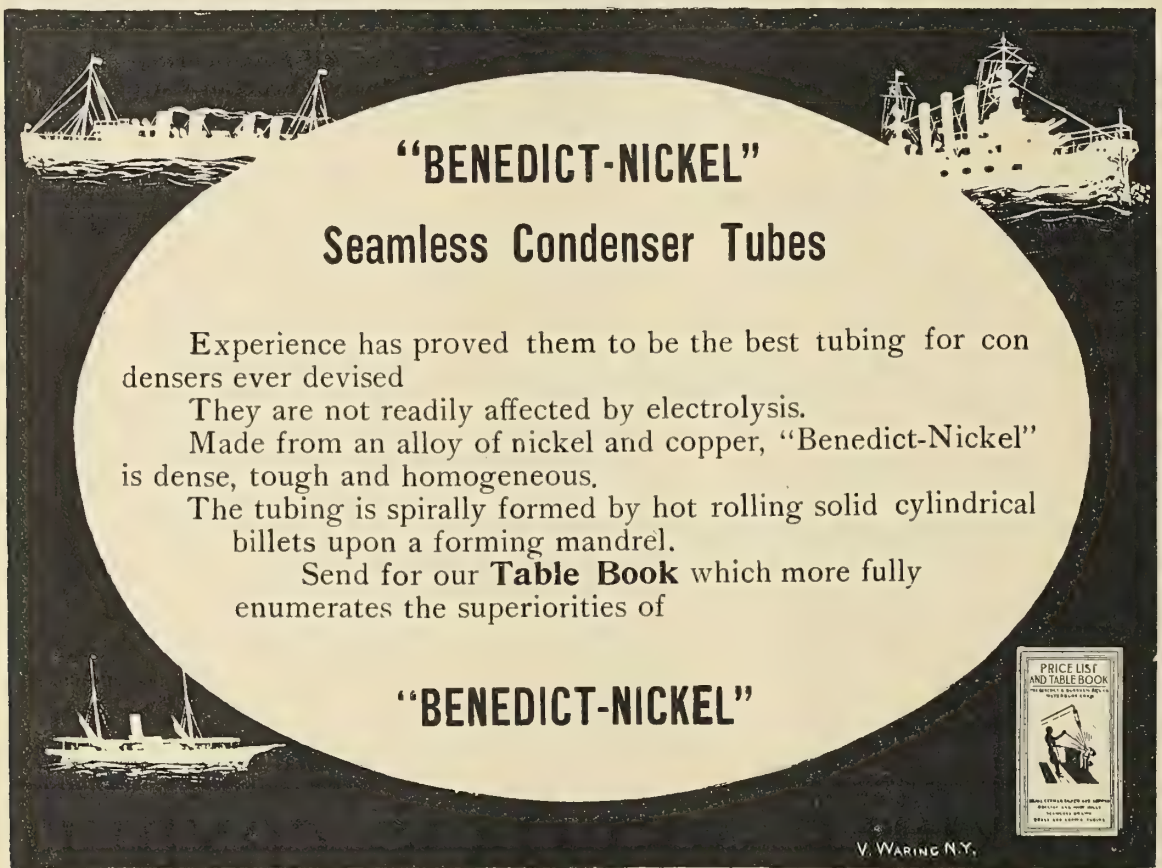
General Offices: 527 531 West 34th Street, New York

Chicago: Fisher Bldg. Boston: Weld Bldg. St. Louis: Security Bldg. Baltimore: Maryland Trust Bldg.

New Lunkenheimer Plant.—The Lunkenheimer Company, Cincinnati, O., sent out very handsomely engraved invitations last month to the many friends of the company to attend the opening of the new Fairmount works.

Care of Electrical Machinery.—James Reilly's Sons Company, 122 to 130 Center street, New York city, make a specialty of keeping marine electrical machinery in order under contract for stated periods. The arrangement is that the company inspects, makes repairs when any damage is done, and keeps all of the electrical machinery in running order, thus relieving the engineering department of much detail in this way. The company carries in stock everything in the line of parts and complete apparatus, so that in case of an accident or breakdown the machinery can be replaced or repaired in the shortest time possible. The contract which the company makes includes the supplying, free of charge, of commutator brushes and all other parts which are necessary to keep the machinery in good order. Full information regarding this contract can be had upon application to the company.

Christensen Air Compressors.—The Christensen Engineering Company, Milwaukee, Wis., with which N. A. Christensen has been connected as superintendent since its organization and is still engaged as consulting engineer, and with whom his other interests remain undisturbed, will hereafter manufacture his air compressors connected with air brakes exclusively. This will place under his control the manufacture of air compressors for all other uses. The air compressors furnished by him will be manufactured by the Christensen Engineering Company, under his designs, specifications, and inspection, insuring the same excellency in design, detail, and workmanship which the products of this company have always possessed. It also leaves him free individually to extend the introduction of his system of air compressors in a rapidly-extending field. There are now in use over seven thousand of these compressors of all sizes and capacities, constructed under his patents and used for various purposes. His engineering and sales offices are located in the Herman Building, corner of Wisconsin street and Broadway, Milwaukee.


"BENEDICT-NICKEL"
Seamless Condenser Tubes
Experience has proved them to be the best tubing for condensers ever devised
They are not readily affected by electrolysis.
Made from an alloy of nickel and copper, "Benedict-Nickel" is dense, tough and homogeneous.
The tubing is spirally formed by hot rolling solid cylindrical billets upon a forming mandrel.
Send for our Table Book which more fully enumerates the superiorities of
"BENEDICT-NICKEL"
PRICE LIST AND TABLE BOOK
V. Waring N.Y.

We are also among the largest manufacturers of Seamless Brass and Copper Tubing (made by the same process as "Benedict-Nickel"), and of brass and copper sheets, wire, etc.

TOBIN BRONZE.—We sell it at manufacturer's prices.

BENEDICT & BURNHAM MFG. CO.,

WATERBURY, CONN.

New York, 253 Broadway. **Boston, 172 High Street.**

COURSE IN NAVAL ARCHITECTURE.—The Board of Education, New York city, has appointed George Crouse Cook, 15 Whitehall street, New York city, a lecturer on Naval Architecture in the courses of free lectures given every year at the various schools under the auspices of the Board. Mr. Cook will carry on this work in connection with his regular work of consulting naval architect and engineer.

MECHANICAL THERMOMETERS.—The Helios-Upton Company, Peabody, Mass., reports a great demand of late for high-class mechanical thermometers for use in the engine and boiler rooms of modern steam vessels. This company makes thermometers for all special purposes, the design being suited to different conditions. The hot-water thermometer is made especially for use in connection with marine boilers and is easily connected to any boiler. Circulars are issued by the company describing fully these instruments and their value.

A Word to the Wise

"McKIM GASKETS"

The long-wear kind. Made of packing encased in soft annealed copper
Can be reapplied indefinitely.
Big and little—for manhole, handhole and pipe fittings.
One grade—the best we can make.
Prices and catalog on request.

McCord & Co.

104 Broadway, New York
1471 Old Colony Bldg., Chicago

FREE SAMPLE OF GRAPHITE PIPE-JOINT COMPOUND.—There is perhaps no better economy to the steam fitter and the engineer than a perfectly tight joint, yet one that can be easily taken apart if desired. It is claimed to be possible to have such joints if Dixon's Graphite Pipe-Joint Compound is used. Flake graphite is impervious to the action of heat or cold, acids or alkalies. Hence the value of a graphite compound when properly prepared. The Joseph Dixon Crucible Company, of Jersey City, N. J., will send booklet and sample free of charge.

REFLEX WATER GAGE.—Wm. T. Bonner and Company, 141 Broadway, New York, report a steadily increasing demand for the Reflex water gage, which is made especially for use on marine boilers. A feature of this gage is that the water appears black, while the steam shines with a silvery luster. This peculiar effect is brought about by the shape of the observation glass. Other features claimed for this gage are, that a quick and reliable observation can be made of the water level; that it is an effective precaution against explosions; a safety against injury to boiler-room employees; that there is a saving in the expense in glass tubes, and that it can be applied easily to existing boiler mounting.

SALE OF PNEUMATIC TOOLS.—The Philadelphia Pneumatic Tool Company, Philadelphia, Pa., reports that the sales for the last two or three months have broken all previous records and that orders continue to come in at an even greater rate. Among the many orders received were some from the New York Shipbuilding Company, the Newport News Shipbuilding and Dry-dock Company, the Cambria Steel Company, the Pennsylvania Steel Company, several large railroad companies, and orders from Paris, London, Copenhagen, and elsewhere. The largest percentage of increase in orders seems to be for rotary drills. Fortunately this company has just added to its machine-shop equipment a large number of lathes, automatic machines, grinders, presses, etc., so that it is in shape to handle all orders promptly.

SPRAGUE ELECTRIC COMPANY.—The annual meeting of the stockholders of the Sprague Electric Company was held October 14, at the office of the company in Watsessing, N. J. The following directors were elected for the ensuing year: Allan C. Bakewell, D. C. Durland, S. M. Hamill, J. R. Lovejoy, John Markle, J. R. McKee, and E. G. Waters. At a meeting of the directors held later in the day, officers were elected as follows: president, Allan C. Bakewell; first vice-president, S. M. Hamill; second vice-president, D. C. Durland; secretary and treasurer, Harry R. Swartz. Col. Bakewell has long been identified with the electrical industry, and has won many friends through his executive ability and honorable business methods. He was vice-president and general manager of the old Interior Conduit and Insulation Company, which was absorbed by the Sprague Electric Company some years ago. D. Clarence Durland, second vice-president, has for the past three years been assistant general manager of the Sprague Company, and his promotion is evidence of his engineering and executive abilities.

WESTON STANDARD PORTABLE DIRECT-READING

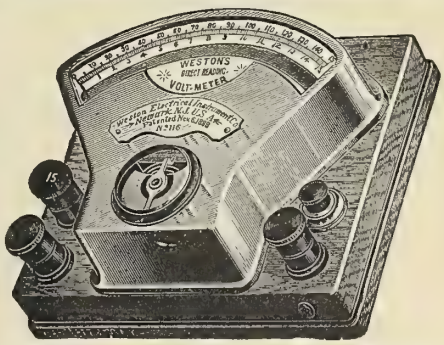
Voltmeters, Ammeters,

MILLIVOLTMETERS, VOLTAMMETERS, MILLIAMMETERS, OHMMETERS, PORTABLE GALVANOMETERS, GROUND DETECTORS, AND CIRCUIT TESTERS.

Our Portable Instruments are recognized as **the standard** the world over. Our **Voltmeters** and **Ammeters** are unsurpassed in point of extreme accuracy and lowest consumption of energy.

WESTON ELECTRICAL INSTRUMENT CO.,
Waverly Park, Newark, N. J., U. S. A.

BERLIN:—Euro ean Weston Electrical Instrument Co., Ritterstrasse 88.
LONDON:—Elliott Bros., 101 St. Martin's Lane.



WESTON Standard Portable Direct Reading Voltmeter.

Patent Attorneys.—Straley, Hasbrouck, and Schloeder, counsellors at law at 257 Broadway, New York city, and who have been doing a large business in the securing of patents, registering of trade marks, and litigation in connection with them, have increased their business so as to make the patent department a more distinct feature. This branch of the business will hereafter be in the charge of the well-known patent solicitor, C. Augustus Dieterich. Mr. Dieterich has had many years of experience in this special work, and everything in the department will be made as complete as possible, so that the patents secured by this firm shall be as comprehensive and as complete as it is possible to be.

Brass and Copper for Marine Uses.—Owing to the large increase of trade in the Philadelphia territory, the U. T. Hungerford Brass and Copper Company, 497-503 Pearl street, New York, has opened a branch office in Philadelphia at 510 Arch street. This branch will not carry very much stock, but will be in direct communication with the New York office, where almost anything that could be called for in connection with marine work of any kind is carried in stock, so that orders can be filled promptly. Three of the best marine salesmen connected with the Hungerford Company will make their headquarters in the Philadelphia branch.

The Temperley-Miller Cableway.—It is announced that the British Admiralty, which recently made very successful tests in coaling ships at sea with the Temperley-Miller marine cableway, which is manufactured by the Lidgerwood Manufacturing Company, 96 Liberty street, New York, has decided to build several special colliers of large displacement, which are to be fitted with this cableway, so that war vessels can be more readily coaled at sea. Spencer Miller, the inventor of this system, has just returned from Europe, where he found much interest in the subject of coaling at sea, and particularly in this cableway. Mr. Miller states that undoubtedly every European power will find it necessary to introduce this system on a large scale in its navy.

The Ideal Pigment

TRADEMARK FEROX REGISTERED JULY 8, 1902.

The only adequate protection for Ships, Bridges, Structural Iron and Steel Work

Mohawk Paint & Chemical Co.

SOLE MANUFACTURERS OF

Patent Iron Oxide Paints

98% Pure

19 Liberty Street, New York

The only **Pure** Iron Oxide Paint.
The only Non-Crystalline Oxide of Iron

Being porous and spongy it absorbs and retains the oil and makes a permanent, durable, unchanging, protective coating for wood and metals.

It is rust-proof and not subject to chemical action.
Unequalled for submarine use.

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REMINGTON

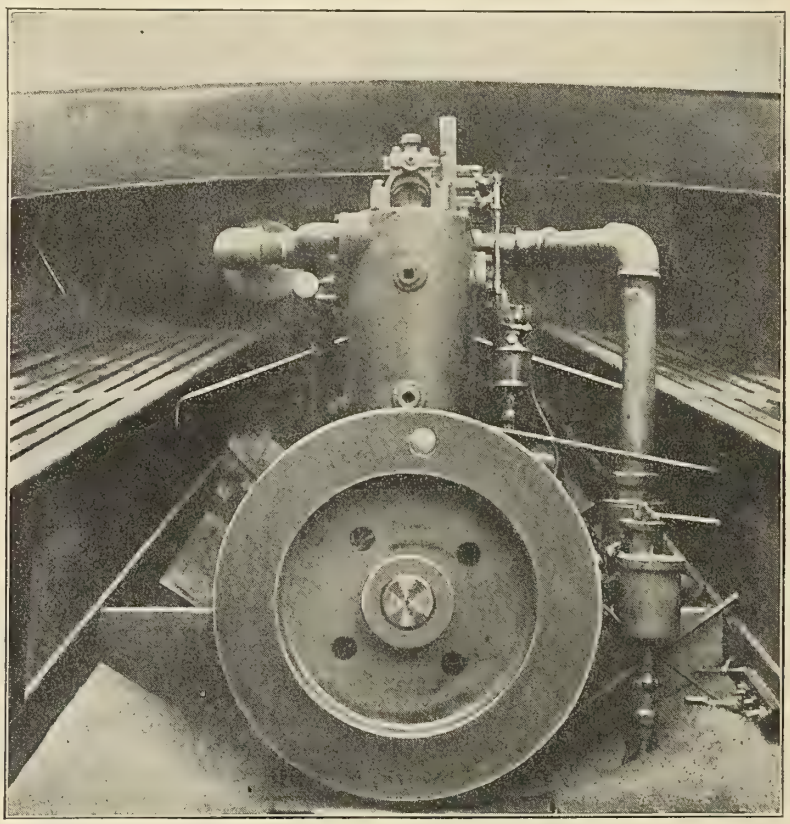
A Great Name
A Great Reputation
A Great Motor

2 Cylinder 4 Cycle Slow Speed

Write for prices now while we can fill your orders.

Remington Automobile & Motor Co.

UTICA, N. Y., U. S. A.



SPECIAL NOTICES

Announcements under this heading will be inserted at the uniform rate of thirty-three-and-a-third cents a line. Lines average ten words each.

MACHINERY DRAFTSMAN WANTED.

We want a First-Class Machinery Draftsman, one with gas-engine experience preferred. Address, giving references, HOLLAND TORPEDO BOAT CO., New Suffolk, L I

AGENCY TO HANDLE MARINE SPECIALTIES.

A man of experience, and who understands fully the trade in Baltimore and vicinity, desires to represent manufacturers of a few leading specialties. Full information can be had by addressing AGENCY, care Marine Engineering

POSITION WANTED AS SUPERINTENDENT.

Position is desired as Superintendent in marine engine works by an active, energetic, seven-o'clock man with seventeen years' experience. Is well posted in all branches of the business. Address M. T., care Marine Engineering.

SHIP DRAFTSMEN WANTED.

Two SHIP DRAFTSMEN are wanted who have had about eight years' experience in drawing office work; must be capable of getting out designs and all details for both merchant marine and naval vessels. Address, giving experience, references, and salary required, SHIP DRAFTSMAN, care Marine Engineering.

CHIEF ENGINEER WANTED.

A CHIEF OPERATING ENGINEER for the power plant of the Western Electric Co., New York City. The plant consists of four 500 H. P. Vertical Cross Compound Engines, eleven Elevators, and various Steam Apparatus. Address applications, stating experience and salary expected, to F. A. MUSCHENHEIM, Asst. Shop Supt., 463 West Street, New York City.

RIVETERS FOR A NAVY YARD.—John F. Allen, 370 Gerard avenue, New York city, who has already sold many portable riveting machines and other tools in many of the ship- and boiler-building establishments of the country, as well as in several navy yards, reports the sale of a 34 1-2-inch reach-jaw riveter for use in the navy yard at Bremerton, Wash.

IMPROVED LAUNCH PLANT.—The gas engine and launch business which has been carried on for some years by Edward F. Leeds, Bridgeport, Conn., has been incorporated under the name of the Leeds Marine Equipment Company. The business has so increased that incorporation was found very desirable, but the policy of the company will remain the same and there will be no change in business methods.

CHANGE OF NAME.—The Cleveland Automatic Machine Company, Cleveland, O., has succeeded to the business formerly conducted by the Cleveland Machine Screw Company. This change is made in order to better harmonize the name of the company with the character of the business. The company has never manufactured screws, but automatic machines for the manufacture of screws. As the company is very largely extending and enlarging its facilities for manufacturing automatic machinery, the reason for the change is very apparent.

MARINE FORGINGS.—Owing to the greatly increased pressure of business in its marine forging department, the Vulcanus Forging Company, Cleveland, O., has installed a large amount of improved and modern machinery, so that the plant has a capacity now of a daily output of over 15 tons. This company makes a specialty of marine and machinery forgings, Government specification rivets, and bolts of all kinds, etc. The present directors consist of F. H. Kindl, formerly chief engineer of the Carnegie Steel Company; A. M. Moreland, president of the Moreland Trust Company, Pittsburg, Pa.; H. L. Snively, treasurer of the Union Potteries Company, Pittsburg, Pa.; A. G. Hathaway, and W. H. Bevis, of Cleveland. The present officers are: F. H. Kindl, president; A. G. Hathaway, vice-president; H. L. Snively, secretary and treasurer; and W. E. Renner, superintendent.

Cabins and Staterooms

of modern vessels especially those in the passenger service should demonstrate the supreme possibilities of the wood finisher's art.

This demands a special varnish, however, as atmospheric conditions are more destructive to varnish afloat than ashore and the ordinary article is of but little use.

The varnish best adapted to withstand the deleterious influences of wind, wave and weather is

Berry Brothers' Spar Varnish.

Further particulars and a unique marine puzzle sent free for the asking. Write us.

Berry Brothers, Limited,
Varnish Manufacturers,

NEW YORK BALTIMORE ST. LOUIS
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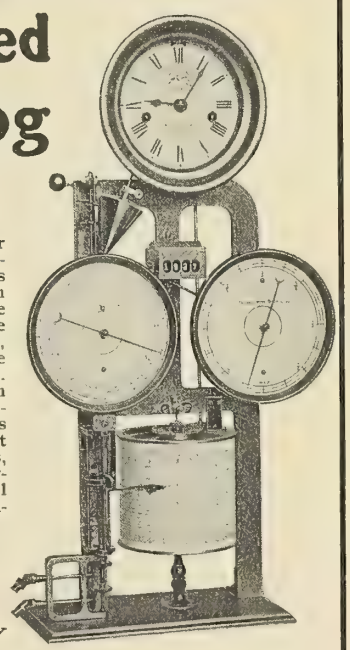
PHILADELPHIA CINCINNATI

Factory and Main Office, DETROIT.

The Nicholson Perfected Ship Log



Tells the speed per hour on a dial, counts the distance traveled and makes a paper record of each day's run. Will show the highest speeds May be placed in the Pilot House, Captain's Cabin, Engine Room or Main Saloon. Well adapted for use on Steamships, Sailing Vessels and Yachts. This is not an electric log, is not connected with engines, and has no line overboard. Catalogs and full information upon application.

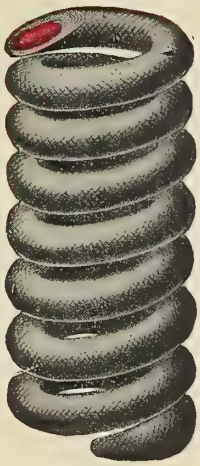
Manufactured by

Nicholson Ship Log Co.
204 Superior Street, Cleveland, Ohio

The Peerless Spiral Piston and Valve Rod Packing

It will hold 400 lbs. of steam

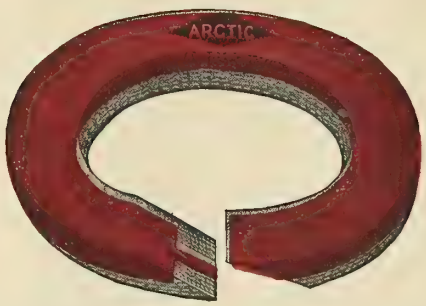
Once tried always used



Will run twelve months in high speed engines

Arctic Packing

To be used exclusively for packing Ammonia Pumps



This packing is made in several hundred sizes

This packing is specially constructed for ice machine service, of layers of rubber and plies of duck which are so arranged and laid as to best resist the actions of ammonia, cold and heat.

The duck is a specially made duck, frictioned with an entirely new compound heretofore unknown to the rubber trade, and the core and back is of the celebrated Rainbow Packing compound, which is specially adapted to resist ammonia, cold and heat.

This packing is constructed on a strictly scientific basis, and the results obtained thus far have demonstrated fully its value for ammonia packing.

This packing is made in several hundred sizes. The rings may be slipped onto the rod very readily.

The usual rule is to be observed in giving measurements, the depth and width of stuffing box and size of piston rod, in order to get the size desired.

Sole Manufacturers of the

Celebrated Rainbow, Eclipse Sectional Rainbow Gasket, Hercules Combination and Honest John Packings.

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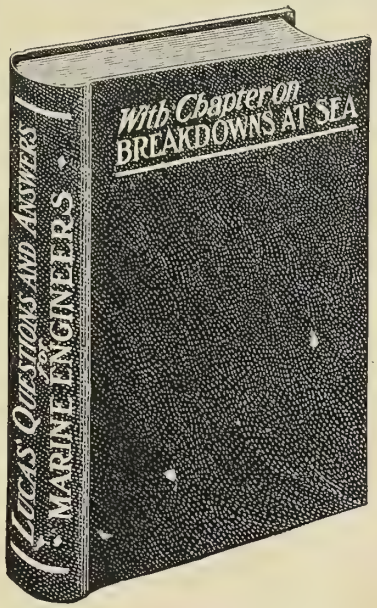
FOR MARINE ENGINEERS



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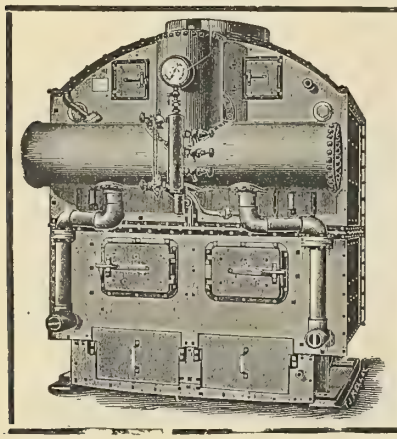

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The Joseph Dixon Crucible Company, Jersey City, N. J., issues a neat four-page folder describing Dixon's silica graphite paint for the protection of heated surfaces. The circular states that the smokestacks of the Fall River steamer *Priscilla* are painted with this paint.

The patent anchors manufactured by L. M. Bowers and Company, Binghamton, N. Y., are described in a catalogue which this company is distributing. Several illustrations are given showing the anchors complete and in section, so as to explain fully the special characteristics of these anchors.

The Providence Engineering Works, Providence, R. I., recently made exhaustive tests of a Rice and Sargent engine which this company installed in the plant of the American Sugar Refining Company, Brooklyn, N. Y. The results of these tests have been published in pamphlet form under the title of "Steam Consumption at Partial Load."

The many types of engines manufactured by the Buffalo Forge Company, Buffalo, N. Y., both horizontal and vertical, are handsomely illustrated in a pocket-sized booklet now ready for distribution. No attempt is made to describe the engines, but each one is handsomely illustrated, so that if the reader is still further interested he can communicate with the company for further information.

Very handsome catalogues are issued by N. A. Christensen, Milwaukee, Wis., describing in much detail and illustrating very thoroughly the air compressors which he manufactures. The compressors vary in size from very small portable ones to compressors of the largest size. In addition to a description of the compressors there is much information regarding the subject of compressed air and pneumatic tools.

The "Ceco" electrical machinery manufactured by the Christensen Engineering Company, Milwaukee, Wis., will be found very fully described and handsomely illustrated in one of the finest catalogues received this month. Each part of the machine is shown in detail, and there are many line drawings showing the design, which any experienced electrician would like to know. There are also many tables giving much valuable data.

The C. O. Bartlett and Snow Company, Cleveland, O., is now distributing Catalogue No. 7, a very complete publication of nearly 400 pages. It is devoted exclusively to the elevating, conveying, and general mill machinery manufactured by this company. The special parts of the magazine most interesting to our readers will probably be the many types of conveying machinery for handling coal and other cargoes in bulk.

An exceedingly interesting application of the De Laval steam turbine is described in a folder issued by the New York Electric Headlight and Train Lighting Company, 52 Broadway, New York city. It comprises one of these turbines direct connected to a dynamo, pump, blower, etc. A number of pictures illustrate the different combinations and explain fully regarding them. Copies of the circular can be had, free, upon application.

The gas engines and launches manufactured by the Lozier Motor Company, Plattsburg, N. Y., are beautifully illustrated and described in book No. 9, copies of which can undoubtedly be had free by any of our readers on applying to the company. The catalogue comprises 44 pages and is an exceptionally fine specimen of printing. The various parts of the engine are illustrated with fine engravings, and altogether it is one of the handsomest engine and launch catalogues we have ever seen.

A free copy of a handsomely-illustrated catalogue describing the Carley life float will be sent to any reader of MARINE ENGINEERING by the Carley Life Float Company, Produce Exchange Building, New York city. The catalogue is bound in paper cover, printed in three colors, and contains many large engravings showing tests made of this float. These pictures add much to the value of the catalogue, as they are taken from life and show what a large number of people can be carried.

When writing to advertisers please refer to MARINE ENGINEERING.

"America Cup Contests and Yacht Green" is the title of a folder issued by S. J. Williams, 11 Broadway, New York. It gives a record of the America Cup contests, with pictures of several of the yachts, together with other interesting information, and contains a color card showing four different shades of Williams' submarine paints.

The Nernst Lamp Company, Pittsburg, Pa., is distributing a catalogue which will interest those who have to do with electricity, as it is devoted to the subject of distribution of light from the Nernst lamp. The special features of this lamp are fully described. It is one of the most recent inventions among electric lamps and has attracted much attention.

The chain blocks manufactured by the Yale and Towne Manufacturing Company, 9 to 13 Murray street, New York, are fully described in a catalogue which this company is sending free to all inquirers. The blocks include: differential, for occasional use; duplex, for general use; triplex, for constant use and best economy, as stated on the title page. The catalogue is completely illustrated.

"Work Done" is the title of a 100-page book issued by Westinghouse, Church, Kerr and Company, Maritime Building, New York city. The book is devoted to very complete descriptions of a number of street railways which have been fully equipped by this company. Not only is the text very complete, but there are numerous half-tone engravings and line drawings giving full information not only of the power plants, but the equipment as well.

The subject of lubrication is covered in a manner to interest every engineer in Catalogue No. 7, copies of which can be had upon application to the Hall Manufacturing Company, 40 Cortlandt street, New York city. Among the various specialties illustrated and described are pneumatic oil cups, sight-feed lubricators of many types, grease cups, oil pumps, oil tanks, and oil filters. This company also handles lubricating compounds and engineers' oiling sets, both of which are briefly referred to.

Draftsmen and others who have to do with blue printing will find much information in the catalogue being distributed by the Pittsburg Blue Print Company, 1505 Park Building, Pittsburg, Pa. This catalogue is devoted to a complete description of the blue-printing apparatus manufactured by this company. A number of full-page illustrations, 4 1-2 by 6 1-2 inches in size, add much to the value of the catalogue in showing the various uses of this machine.

Metal melting and refining furnaces of the Schwartz type have a special catalogue devoted to them, issued by the manufacturer, the Hawley Down-Draft Furnace Company, 85 Liberty street, New York city. There are several illustrations showing the construction and arrangement of the furnace, and much information is given regarding its purposes and operation. There are also letters from well-known manufacturers, United States navy yards, and elsewhere, telling of the value of the device.

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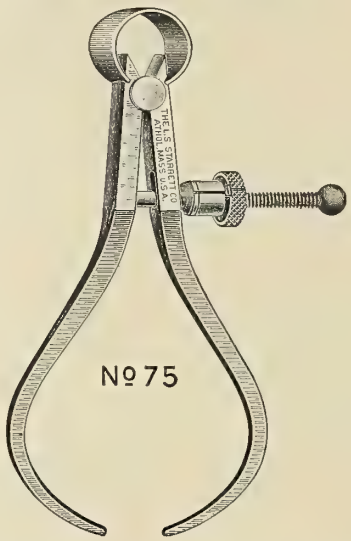

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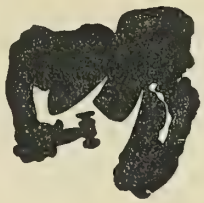

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"Galvanum, a Paint that Will Adhere to Galvanized Iron," is the title of the latest publication issued by the Goheen Manufacturing Company, Canton, O. The value of this paint for covering galvanized iron and other metal surfaces is fully shown in the text.

The Waterbury Brass Company, 122 to 130 Center street, New York, issues frequent bulletins regarding special lines of brass, copper, and bronze specialties which are in stock. All readers of MARINE ENGINEERING who are at all interested in these specialties will have these bulletins sent each issue upon notifying the company.

A very neat folder is issued by the United States Gutta Percha Paint Company, Providence, R. I., devoted exclusively to describing this company's gutta percha rivet cement for hulls of steel or iron vessels. The special features of the cement are fully described and instructions are given as to how to apply it, together with testimonials, etc.

The sight-feed lubricators, oil cups, oil pumps, grease cups, and other oiling devices, either for steam or gas engines, manufactured by the G. B. Essex Brass Company, Detroit, Mich., will be found described in a catalogue which this company will send to any inquirer free upon application. The catalogue contains 34 pages and is one that will interest every engine man.

The thermometers for mechanical uses which are manufactured in great variety by the Helios-Upton Company, Peabody, Mass., will be found fully illustrated and described in a 12-page folder which this company is distributing. Thermometers are so extensively used nowadays on board ship and in land plants for testing hot water and for use in connection with refrigerating machines, and for many other purposes, that this folder will be of much interest.

The Rand Drill Company, 128 Broadway, New York, will send to all readers of MARINE ENGINEERING who are interested in the subject of compressed-air and pneumatic tools a handsome catalogue describing the Imperial air compressors, which this company manufactures. The catalogue contains a number of fine engravings, with much detailed description of the several types of machines. This text, in connection with the several tables, gives a great deal of valuable information.

The Howard Electric Novelty Company, Center and Howard streets, New York, will send to all readers of MARINE ENGINEERING, upon request, a free copy of an interesting catalogue describing a great variety of electric novelties and dry batteries which this company manufactures. These include hand flash or search lights, such as are used frequently in searching out dark places in engine rooms, electric lighters in variety, electric scarfpins, clocks which can be illuminated by pressing a button, together with many other forms of ornamental and useful novelties.

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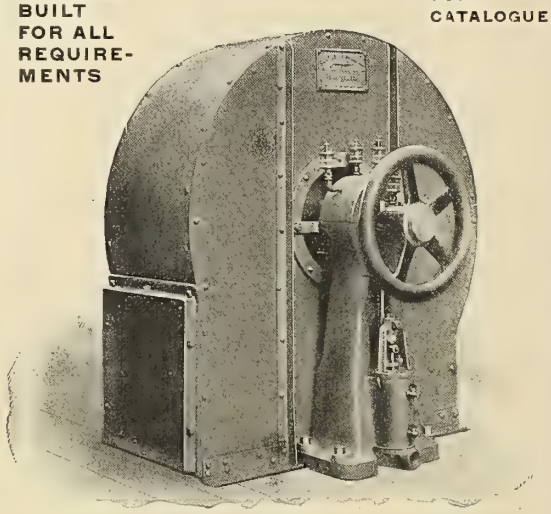

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The latest short story of the world's great engineers, issued by Wyman and Gordon, Worcester, Mass., is devoted to the great German iron manufacturer, Alfried Krupp.

The Fort Wayne Electric Works, Fort Wayne, Ind., has issued a number of new bulletins. Bulletin No. 1035 is devoted to electrostatic ground detectors, and Bulletin 1027 to enclosed, alternating-current, 104-volt arc lamps.

Mechanical Induced Draft is one of the latest publications of the Buffalo Forge Company, Buffalo, N. Y. The catalogue is pocket size and is given over almost exclusively to illustrations of different types and styles of installations.

The Wilgus marine oil burner, which is designed specially for use in Scotch marine boilers, has a folder devoted to it, which is being distributed to all inquirers by the Wilgus Manufacturing Company, 52 Natoma street, San Francisco, Cal.

The Modern Machine Shop Outfit is the subject of the latest catalogue issued by the Garvin Machine Company, Spring and Varick streets, New York. It comprises 56 pages and contains a large number of illustrations of all sorts of tools, large and small, such as would be called for in the equipment of a small and medium-sized machine shop.

The ice-making and refrigerating machines manufactured by the Brown-Cochran Company, Lorain, O., have a very neat catalogue devoted to them. It is particularly well printed and neatly illustrated, showing the several types of refrigerating plants for yachts and vessels of various sizes which this company manufactures. Copies can be had by writing to the company.

Large Sale of Packing.—We are informed by the Holmes Metallic Packing Company, Wilkesbarre, Pa., that the past three months have shown the largest demand for this company's metallic packing in the history of the company.

AD-EL-ITE

Paint AND Varnish Remover

REMOVES CLEAN TO THE WOOD INSTANTLY

Varnish, Shellac, Wax Stains or Paint from furniture, floors or woodwork. Applied with brush, and wipes off clean with rags or cotton waste. So simple a child can use it. Does not injure hands or finest grained woods. Fresh varnish or paint can be applied immediately after use and make a finish just like *new*. Makes old woodwork new.

FREE. Send us 10c. for packing and mailing sample sufficient for full trial.

ADAMS & ELTING CO.,

MANUFACTURERS OF

Wood Finishes and Enamels, Deck Paints. Smoke Stack Black and Paint Specialties.

DEPT. H, - - CHICAGO, ILL.

BUSINESS NOTES.

GOLD MEDAL AWARDED.—The C. W. Hunt Company, West New Brighton, Staten Island, has been awarded the highest award of merit—a gold medal—at the Düsseldorf Exhibition, recently held in Germany. The award was made to this company for its conveyor.

FREE TOOLS TO ENGINEERS.—The Mound Tool and Scraper Company, 710 Howard street, St. Louis, Mo., which makes a line of special tools for engineers, offers to send free to any reader of MARINE ENGINEERING who is an engineer a sample packing tool, if the letter is received within a month and MARINE ENGINEERING is mentioned in the letter.

BIG INCREASE IN PLANT.—The Russell and Erwin Manufacturing Company, New Britain, Conn., has placed a contract for the erection of a new building, to be 50 feet wide, 200 feet long, and seven stories high. The construction of the building is to be fireproof throughout, and the floors will have a capacity of 250 pounds per square inch. It is hoped to have the building ready for use by February 1, so that the company will be in shape to handle orders of any size for this company's tools and many other specialties.

MARINE GLUE.—Frederick Shapley and Company, 246 Front street, New York city, are making a specialty of Shapley's United States Marine Glue. This glue is made in either black or deck color, and the following claims are made for it: that it is absolutely water-proof, firm under heat, flexible under cold; that it will not track over the deck, will not melt or become sticky under tropical heat, will not oxidize or rot, yet has all the qualities of rubber. Much information regarding this glue and pictures showing its use is given in a circular issued by this company.

PAINT AND VARNISH REMOVER.—The Adams and Elting Company, Chicago, Ill., reports the greatest demand ever experienced for Ad-el-ite, which this company is selling in enormous quantities for removing paint and varnish. Ad-el-ite is furnished either in liquid or semi-paste form, and the special claims made for it are that it contains no water, alkali, or acid; that it is free from objectionable odor, and does not injure the hands; by its use varnish, paint, shellac, or wax can be wiped clean from the wood within three minutes; it does not affect the glue, does not raise the grain of wood or veneers, does not spot or injure the wood; that it cleans all woodwork for a much less cost than any other process; that it is not only cheap, but thoroughly reliable; that it does not evaporate like alcohol, and that one gallon will entirely remove from 200 to 300 square feet of finished surface. The company makes a very generous offer to those who have not used this remover but who wish to give it a test, as will be seen by the advertisement on another page.

HEATING APPARATUS.—The American Blower Company, Detroit, Mich., has received a large number of orders lately for heating apparatus for large plants, including the buildings of the Lackawanna Steel Company, of Buffalo; the Pittsburg Valve Foundry, Pittsburg, Pa.; the Fox Typewriter Company, Grand Rapids, Mich.; National Malleable Castings Company, Sharon, N. Y.; etc.

MARINE CUSHIONS AND BEDDING.—A recent visit to the factory of M. W. Fogg, manufacturer of cushions, mattresses, and marine upholstery, 202 Front street, New York, gives an interesting idea of the working of a model factory devoted entirely to the manufacture of interior furnishings for steamships, yachts, etc. The ground floor is used for a showroom and office, wherein are shown many of Mr. Fogg's specialties. The office partition has been made to represent a yacht's cabin, the cushions being of a light shade of red leather, with empire green draperies for the windows, making a very fine effect. Upstairs, Mr. Fogg has every improvement and convenience that can be utilized in his business. The second floor is used for cutting and operating. All the sewing machines are run by individual electric motors. On the third floor the construction and filling of mattresses and cushions is attended to, while on the upper floors all the stock of hair, felt, cork, etc., is carried. One feature of the top floor is the large electric motor which is used to run the elevator and exhaust fan. The latter, running at high speed, can draw every particle of dust from the room in a few minutes.

For Steam Making Refrigerating Apparatus

MECHANICAL THERMOMETERS

HOHMANN & MAURER MFG. CO. ROCHESTER, N.Y. TRADE H&M MARK

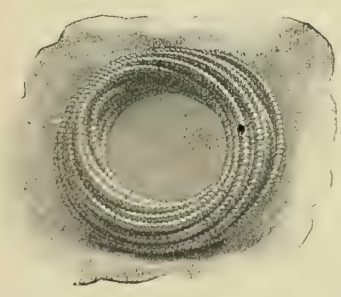
For All Engineering and Manufacturing Purposes

Write for Illustrated Catalogue M.

NEW YORK 85 Chambers Street
CHICAGO 119 Lake Street
LONDON 57D Hatton Garden

FLEXIBLE METALLIC CONDUIT

For Modern Electric Wiring



Our Flexible Metallic Conduit, Flexible Steel Armored Conductors, and Steel Armored Flexible Cord are particularly well adapted to all classes of Marine work. They afford thorough protection to the wires and insulation from rodents, mechanical and other injuries, are water-proof and simple to install.

Write for Catalogue No. 40415

SPRAGUE ELECTRIC COMPANY

General Offices: 527-531 West 34th Street, New York

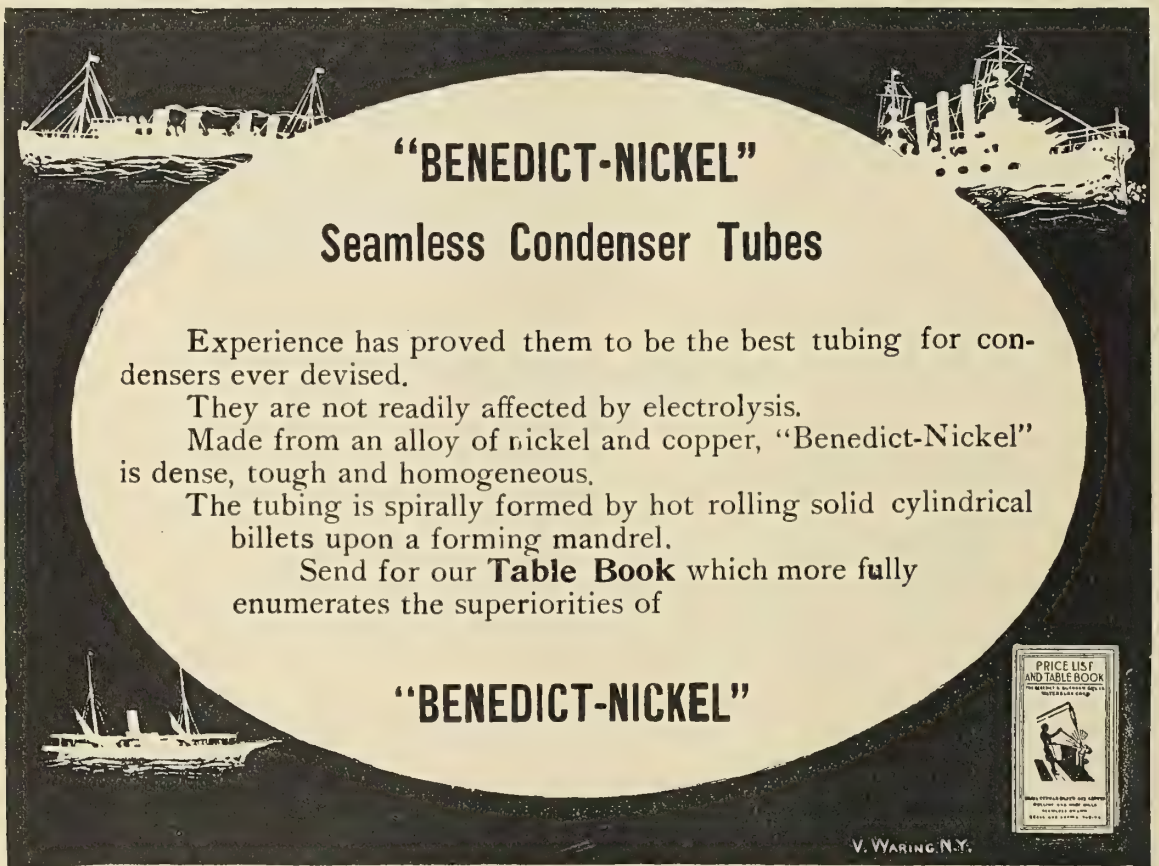
Chicago: Fisher Bldg. Boston: Weld Bldg. St. Louis: Security Bldg. Baltimore: Maryland Trust Bldg.

An Electrically-Equipped Plant.—The Sherwin-Williams Paint Company, Cleveland, O., has had its entire plant equipped with electric power. A large number of motors have recently been purchased from the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., so that all of the machinery used in paint and varnish making is operated by motors. The same equipment has been applied in the Newark factory as well as in the one at Cleveland.

Marine Hardware.—P. and F. Corbin, New Britain, Conn., are just about building extensive additions to their plant. Included in the additions is a seven-story fireproof building to be used for general manufacturing purposes and a new foundry, to be 60 feet wide and 600 feet long. These improvements will probably be finished at the beginning of the new year, and will necessitate the employment of 100 additional iron molders, 70 brass molders, and 500 extra hands in general manufacturing, thus giving a very large capacity for marine hardware and the many other specialties of this company.

Vessels Classed.—The American Bureau of Shipping, 66 to 70 Beaver street, New York, has recently classed in its Record of American and Foreign Shipping the following vessels: American schooners, *Edgar W. Murdock, Lydia M. Deering, Samuel W. Hathaway, William Bisbee, Phineas W. Sprague;* American barkentine *St. Paul,* and British schooner *Empire*

Test of a Lidgerwood-Miller Cableway.—Details have just been received of an interesting test of the Lidgerwood-Miller marine cableway for coaling at sea which was installed early in the year on board the Russian battleship *Retvizan.* The trial took place September 12 in the Baltic Sea, under the direction of a Board of Inspectors appointed by the Russian Government. A letter received from J. Skorohodof, Lieut. I.R.N., who was present at the test, states that the result was in every way most satisfactory to the trial board. The system was manufactured by the Lidgerwood Manufacturing Company, 96 Liberty street, New York, and installed under the direction of Mr. Spencer Miller, the inventor.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Seamless Condenser Tubes
Experience has proved them to be the best tubing for condensers ever devised.
They are not readily affected by electrolysis.
Made from an alloy of nickel and copper, "Benedict-Nickel" is dense, tough and homogeneous.
The tubing is spirally formed by hot rolling solid cylindrical billets upon a forming mandrel.
Send for our Table Book which more fully enumerates the superiorities of
"BENEDICT-NICKEL"
PRICE LIST AND TABLE BOOK
V. Waring, N.Y.

We are also among the largest manufacturers of Seamless Brass and Copper Tubing (made by the same process as "Benedict-Nickel"), and of brass and copper sheets, wire, etc.

TOBIN BRONZE.—We sell it at manufacturer's prices.

BENEDICT & BURNHAM MFG. CO.,

WATERBURY, CONN.

New York, 253 Broadway. **Boston, 172 High Street.**

THE
McKIM GASKET

A profitable Gasket to buy because of its great durability.

Made of rubber encased in soft rolled copper—extra annealed—so that it will accommodate itself to faced or rough joints, and withstand abnormal pressure, temperature or circulation.

Made in all sizes for manhole, handhole and pipe fittings.

Write for Prices and Catalog.

McCORD & CO.
104 Broadway, - New York
1471 Old Colony Bldg., Chicago

FREE!! GIVEN TO all ENGINEERS SENDING US A TRIAL ORDER

A bound book on Engineering, valued at $1.50. We are sole agents for the best line of Asbestos Packings on earth. Including Sheeting, Piston, and Gaskets

BESTOSKING PACKING & SUPPLY CO.,
170 Summer St., Boston
Agents for
TURNER BROS., ROCHDALE, ENGLAND

SCHOOL SHIP YOUNG AMERICA.—Contract has been placed with the Perth Amboy Shipbuilding and Engineering Company, Perth Amboy, N. J., to build a ship to be called *Young America*, which is to be used as a school for the education of boys. The ship will have accommodations for about 600 boys, and while they are being prepared for one of the Government academies, or for college, they will be cruising round the world. The vessel will be dependent entirely upon sails and will be of about 2,600 tons burden.

NEW LUNKENHEIMER PLANT.—The Lunkenheimer Company, Cincinnati, O., manufacturers of brass and iron goods and specialties for engines, boilers, etc., such as brass and iron valves, whistles, injectors, lubricators, oil and grease cups, etc., on Saturday, October 25, formally opened its new works to about three thousand visitors and friends, and is now moved from the old quarters on Eighth street to the fine new plant. The buildings, of which there are five, represent an investment of over $300,000, consisting of the main building, occupied by the brass department, with adjoining buildings for the iron department, brass foundry, power building, and office building; all are of pressed brick and steel construction of modern type. They occupy about three acres of ground and have switching facilities; three acres additional ground provide for future extension of the business. The foundry is equipped with modern appliances, such as overhead track system for carrying material, smelting furnaces burning crude oil, and many pneumatic appliances, such as are used in the latest foundry practice. The general distribution of power throughout the buildings is the latest. The source of energy is a 300-horse-power compound engine, which drives a 240-K.W., three-phase, 220-volt, General Electric, alternating-current dynamo. The current is led out from a switchboard to the different parts of the buildings, where suitable motors (principally attached to the ceiling) are provided to drive the various lines of shafting. These motors are of the Westinghouse and General Electric induction type, without commutators or brushes. The power from the motors to the shafts is transmitted through what is known as the Renold Silent Chain Gear, which permits of a very compact arrangement without noise and friction, thus dispensing with leather belts. Telephones connect all departments to a central exchange, which connects with the city lines, thus affording immediate communication from any point in the works. The business was founded in 1862 by the late Frederick Lunkenheimer, and has grown to large proportions, now employing over 700 men. With increased facilities the company expects to extend its line and take up many new engineering specialties. The company's trade is domestic and foreign, being distributed largely through jobbers; there is a branch store in London, England, and an office in New York city. The company has placed many orders for additional tools and machinery, which are being installed rapidly.

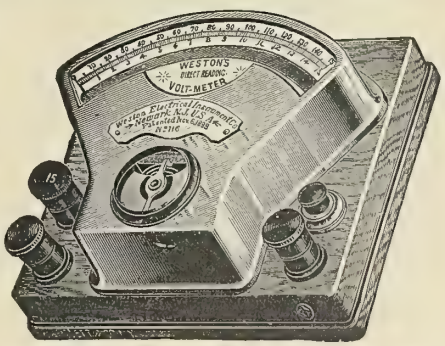
WESTON STANDARD PORTABLE DIRECT-READING
Voltmeters, Ammeters,

MILLIVOLTMETERS, VOLTAMMETERS, MILLIAMMETERS, OHMMETERS, PORTABLE GALVANOMETERS, GROUND DETECTORS, AND CIRCUIT TESTERS.

Our Portable Instruments are recognized as **the standard** the world over. Our **Voltmeters** and **Ammeters** are unsurpassed in point of extreme accuracy and lowest consumption of energy.

WESTON ELECTRICAL INSTRUMENT CO.,
Waverly Park, Newark, N. J., U. S. A.

BERLIN:—European Weston Electrical Instrument Co., Ritterstrasse 88.
LONDON:—Elliott Bros., 101 St. Martin's Lane.



WESTON Standard Portable Direct Reading Voltmeter.

New Shipbuilding Company.—The Manitowoc Dry-Dock Company has been organized at Manitowoc, Wis. This company has purchased the shipyard and plant formerly owned by Burger and Burger; also a plant in Chicago. The Manitowoc yard for many years has devoted itself to wooden hulls and repair work. The new company is installing a complete line of tools and equipment for building steel hulls. George Burger will be superintendent of the company. In connection with the plant is a 340-foot dry-dock. The Chicago yard is on the north branch of the Chicago river, and will be equipped with a modern floating dry-dock, as well as having ample facilities for building and repairing of all kinds.

France Metallic Packing.—Now that metallic packing is used so extensively on propelling and other engines in connection with marine work, and because of the greatly-increased demand, A. W. France, Tacony, Pa., has found it necessary to so largely increase his business that he has organized it into a stock company, with a capital stock of $100,000. Hereafter the business will be under the name of the France Packing Company, Incorporated. The company has installed a large amount of automatic machinery and in other ways greatly increased the facilities of its plant. With these increased facilities, the company is now able to fill all orders promptly. Among the new specialties of this company is metallic packing for use in ammonia machines. A recent letter from Chief Engineer Mitchell, of the Atlanta Ice and Coal Company, states: "I put in two sets of your packing on two of our ammonia rods last spring, and have not had to touch them since. The same rods cost us a good many hundreds of dollars the year before in loss of oil and ammonia, cost of packing, and, incidentally, a heavy loss of output on account of frequent stops. Your packing is running under an ammonia pressure of 200 o 250 pounds per square inch."

The Ideal Pigment

TRADEMARK FEROX REGISTERED JULY 8, 1902.

The only adequate protection for Ships, Bridges, Structural Iron and Steel Work

Mohawk Paint & Chemical Co.

SOLE MANUFACTURERS OF

Patent Iron Oxide Paints

98% Pure

19 Liberty Street, New York

The only **Pure** Iron Oxide Paint.

The only Non-Crystalline Oxide of Iron

Being porous and spongy it absorbs and retains the oil and makes a permanent, durable, unchanging, protective coating for wood and metals.

It is rust-proof and not subject to chemical action.

Unequalled for submarine use.

SEND FOR DESCRIPTIVE CIRCULAR

THE ENGINE is the important thing about a boat. Might much rather use oars than an Engine that is not absolutely reliable.

THE REMINGTON

has a great name and equally great reputation, and is absolutely reliable.

TWO CYLINDERS FOUR CYCLE SLOW SPEED

WRITE FOR PRICES NOW WHILE WE CAN FILL YOUR ORDER

Remington Automobile & Motor Company

UTICA, NEW YORK, U. S. A.

YACHT BROKERAGE BUSINESS.—Charles G. Davis and Walter B. Bieling have organized under the name of Davis and Bieling and opened offices at 50 Broadway, New York, for the transaction of a general yacht-brokerage business.

CHANGE OF OFFICE.—Arthur Masters, naval architect and yacht broker, at 29 Broadway, New York, has moved into larger and more commodious offices at the same address. He is now in room 42 on the second floor.

A SUCCESSFUL INVENTOR.—A recent issue of the *Successful American* contained a very complimentary article regarding Mr. N. A. Christensen, Milwaukee, Wis. From this account we learn that Mr. Christensen was born in Denmark in 1865 and that as a lad he showed marked mechanical ability. After graduating at the technical institute in Copenhagen, he entered the Danish navy as a constructor, and filled many prominent positions, being promoted with much rapidity. Desiring to see more of the world, he resigned his commission and went to sea on an English merchant marine vessel, for the opportunity to learn the English language as well as to study marine engineering in a practical form. He went to several parts of the world, and in 1891 came to this country, where he became consulting engineer of the Fraser-Chalmers Company, Chicago. In 1894 he went to Milwaukee as designer for the E. P. Allis Company, where he remained until 1896. Meantime he had been doing much experimenting with compressed air, and took out many patents on machinery in this special line. After much litigation his patents were found valid, and many of the electrical roads throughout the country immediately adopted his air brake and other inventions. Meantime a large plant had been built, and now his many inventions are used in all parts of the country. Mr. Christensen will hereafter devote himself exclusively to further developing his inventions in the specific field of compressed air.

Cabins and Staterooms

of modern vessels especially those in the passenger service should demonstrate the supreme possibilities of the wood finisher's art.

This demands a special varnish, however, as atmospheric conditions are more destructive to varnish afloat than ashore and the ordinary article is of but little use.

The varnish best adapted to withstand the deleterious influences of wind, wave and weather is

Berry Brothers' Spar Varnish.

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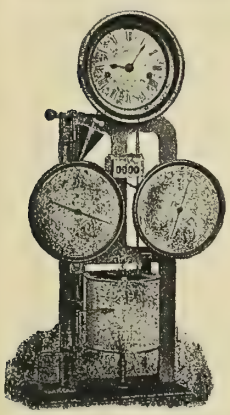


The Nicholson Perfected Ship Log.

Detroit, Mich., October 3, 1902.

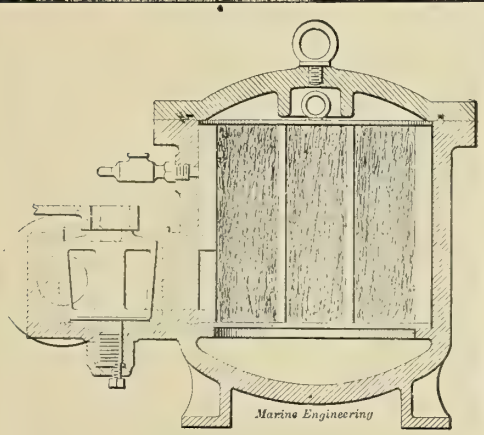
NICHOLSON SHIP LOG CO.,
CLEVELAND, O.

Dear Sirs:—Both logs are doing all that can be expected of them. Last night—up—it registered from Long Point to S. E. Shoals lightship, 134 miles in a northwest gale, and that is about as correct as it can be. If the distance taken off the chart is correct, the records of your logs are. Respectfully,

CAPT. JOHN McCALLUM,
Master, Stmr. Western States.

CATALOGUES ON APPLICATION.

NICHOLSON SHIP LOG CO., 204 SUPERIOR STREET, CLEVELAND, O.



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will pay for themselves in less than one year by protecting your BOILERS from grease, oil, and all other mechanical impurities ?

IF NOT, write us at once for full particulars.

For use on Steamships, Yachts, Tugs, and in Hotels, Apartments, Factories and Mines.

TRY THEM, and if you don't like them send them back and we WILL REFUND the Purchase Price.

BLACKBURN SMITH CO., 29 BROADWAY NEW YORK

Davidson Ash Ejector.—The September issue of *The Steamship*, published at Leith, Scotland, contains a fine illustration of the Davidson Ash Ejector, manufactured by M. T. Davidson, 141 Broadway, New York, and in referring to it says: "This apparatus is being largely adopted in America on account of its reliability and the ease and rapidity with which it disposes of the ashes."

Thorne's Patent Ash Ejector.—Many testimonials have been received by Fred H. Pell, 11 Broadway, New York, from users of the Thorne patent ash ejector. Mr. Schermerhorn, owner of the steam yacht *Freelance*, writes: "The Thorne patent asn ejector has been in use on the *Freelance* for four months and has given entire satisfaction." Chief Engineer Clifford, of the steam yacht *Hauoli*, writes: "It gives me pleasure to state that the Thorne patent ash ejector does all and more than you claim for it. It is a No. 4 and will eject ashes as fast as two men can shovel into the hopper. It works well with 60 pounds pressure. Our discharge pipe is under water, and we have no trouble whatever with it."

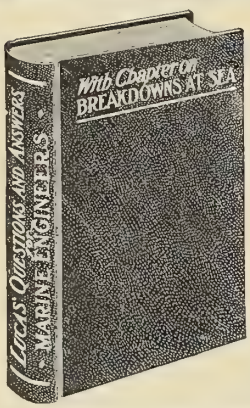
Yacht and Marine Insurance Agency.—Roger Upton has opened offices at 24 Warren street, Salem, Mass., as a yacht specialist and marine insurance agent. His purpose is to have confidential understanding with owners of yachts of all kinds, so that he will be in shape to provide customers, whether it be to purchase or to charter a yacht or to build one. Anything that is desired in the way of caring for, or disposing or making use of, yachts in any way will be Mr. Upton's specialty. Included in this, of course, will be the protecting of the yachts by means of insurance, and otherwise keeping them in first-class order. To those who contemplate building a yacht, Mr. Upton offers his services as a specialist on the subject of design and arrangement. Full information regarding his services may be had by applying to him.

Sails for Australia.—Wilson and Silsby, Rowe's Wharf, Boston, Mass., continue to have demand for sails from Australia, and have just shipped two sets for well-known racing yachts.

International Gas Engines.—The International Engine Works, Mariner Harbor, Staten Island, are distributing a little folder giving a large-sized picture of a double-acting 16 horse-power gas engine with a reversing clutch. The claims made for this engine are: durability, simplicity of construction, lightness, small floor space used, power, speed, safety, economy, steadiness of motion, and self-starting. These engines are made specially for marine uses in sizes from 6 horse power up.

Emergency Accident Case.—The emergency case manufactured by the Adolph Levy Company for use on board ship or in shipyards and engine rooms deserves attention. This case contains everything that is necessary to be used in case of an accident, and from the names shown on the circular is in very general use. The last Baldwin-Ziegler expedition to the pole carried ten of these cases. Any of the readers of Marine Engineering interested will find it worth while to send for a catalogue, at 127 East Twenty-third street, New York.

Interesting Booklets Free.—George H. Daniels, General Passenger Agent of the New York Central and Hudson River Railroad Company, Grand Central Station, New York city, has issued two interesting pamphlets, copies of which are sent free to all inquirers. One is entitled "Bronx Park, New York Zoological Garden, the Largest in the World, and the New York Botanical Gardens and Museum, also the Largest in the World." The folder describes fully these and other features of the park, and gives in detail the easiest way to reach the park, which is by means of the New York Central Railroad. The other folder describes historical pilgrimages around New York and along the Hudson river, as reached by the New York Central Railroad.



Lucas' Questions and Answers
For MARINE ENGINEERS.

This is a book for practical men—strictly up to date—of great assistance in preparing for examinations for a higher grade, as well as a work for every-day use.

The volume is strongly and durably bound in rich red cloth with full gilt edges, and titles in gold; it contains 516 pages; it is 7½ x 5 inches, 1½ inches thick, and weighs nearly 2 lbs.; it is illustrated with 12 large plate engravings, 66 full, 83 half-page, and many other diagrams and illustrations; it has an index with more than 1,000 ready references.

GENERAL OUTLINE OF CONTENTS.

Naturally the book divides itself into two parts—1, Construction; 2, Operation; it has 807 Questions with carefully prepared answers, with nearly 300 explanatory footnotes.

The various types of the marine steam-engine are fully explained, with description of the stationary parts (cylinders, bed plates, etc.) and moving parts (valves, gears, piston, piston-rod, etc.) and the operative details of a marine engine. Paddle Wheels and Screw Propellers, the auxiliary apparatus, piping and pipe connections, are all taken up separately.

All types of steam boilers are described, with details of the construction of fire- and water-tube boilers, the operative details of marine boilers, fuel and fire-gases, combustion, steam and its properties.

Five chapters are devoted to the Care and Operation of a Marine Engine, including lubricants and lubrication, packing and packing materials, care and overhauling in port, laying up a marine engine, and its care and operation under way. A chapter is devoted to Breakdowns and Repairs, as also one to Constructive Materials and Tests of Strength; and in an Appendix, Spare Parts and Tool Outfits are described.

Price, $2.00. Sent post-paid to any address. See order coupon. Money refunded if not satisfactory. Send for free catalog.

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Educational Publishers,

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M.E.

Date.....

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